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PROCEEDINGS

OF THE

NINETEENTH ANNUAL CONVENTION

OF THE

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS

HELD AT DALLAS, TEXAS
NOVEMBER 12th, 13th, 14th and 15th
1912

BALTIMORE
WILLIAMS & WILKINS COMPANY
1913

THE 1913 CONVENTION

WILL BE HELD AT

WILMINGTON, DELAWARE

OCTOBER 7th, 8th, 9th and 10th

Transf.
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19209

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PAPERS AND DISCUSSIONS

REPORT OF COMMITTEE ON STREET LIGHTING

Under our advanced civilization the need of good street lighting is keenly felt. Different forms of lighting have been developed to meet new conditions. Increased business transactions and agencies of transportation, as well as the recreation-seeking public require, more and more, the use of streets at night. Street lighting of such a nature is demanded, therefore, as will afford protection and prove an aid in the detection of crime, and the elimination of accidents and fatalities.

Protection is the obligation of the city to its inhabitants. They, as tax payers, demand that such needful service be rendered. An adequate police force is impossible without the assistance of a sufficient street lighting system, and good lighting of streets is of no little value to the public, in the way of self protection. Transforming a thoroughfare so that it becomes a promenade, instead of a highway, eliminates greatly the successful commission of crime and literally lights out the evil.

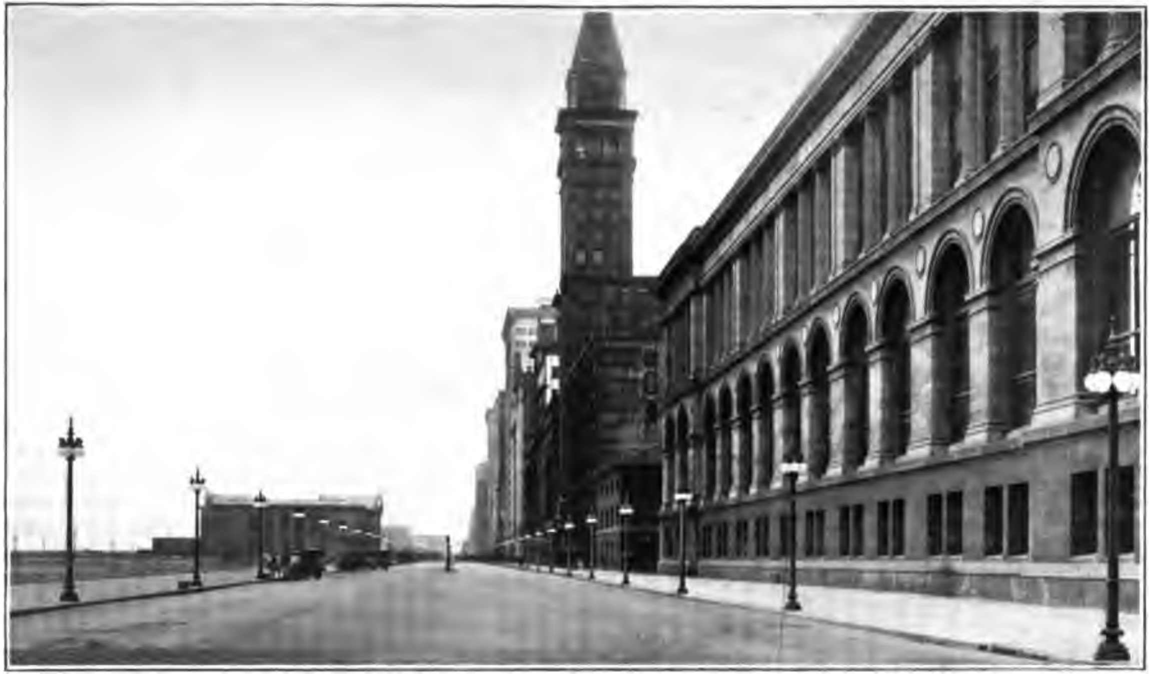
We find that good street lighting means municipal advertisement, sanitation and progress, to the community at large. Advertisement emanates from the favorable impression given the transient public, and the attraction presented to visitors from adjacent towns and territories. Sanitation results from the power of suggestion; one improvement suggests another. Unclean streets, so much more unsightly under good night illumination, inspire the populace to carefullness in the disposition of litter and refuse upon the streets. Municipal authorities have an incentive to be more particular in their street cleaning. Progress must be the ultimate outcome of increased efficiency. We find that ornamental street lighting systems are instrumental in producing better pavements, and in the general improvement of street curbs and sidewalks. Street lighting is being recognized as one of the very important public utilities. As symbolic of welfare and prominence, it stands second to none in our so-called city land-marks, such as public buildings, good roads, sewage disposal, etc.

Civic pride enters materially into the question of municipal street lighting. The possession of something which has been worked out by one's own endeavors is cherished far more than a rich man's gift. This feeling has produced failure and dissatisfaction, to a certain extent, where city competition has been felt so forcibly that a burdensome lighting expense, in proportion to the size and wealth of the community, has been the result.

Before entering into the discussion of the four distinct classes of street lighting, namely: business district; residence district; suburban districts; public parks, drives and boulevards; your committee desires to bring before you certain important considerations akin to proper street illumination; also to emphasize the practices which in the past have held back the progress of street lighting in America.

Good street lighting is the result of applied common sense, by some one with illumination knowledge and experience. The weighting factors are economy and distribution of intensity; one being limited by the other. To fix specific rules would be impossible, due to the variables dependent on installation, operation and maintenance. Uniformity is subordinate to the distribution of light from the source, diffusion, lack of flicker and of sharp shadows. The distribution of light from the source is of importance, for upon it is based the design of the system. An ideal unit would have its maximum candle power from 25 to 35 degrees below the horizontal; thereby lending itself to such location as would eliminate a very objectionable effect, known as glare. Glare is produced by light rays from any source striking the eye within the angle of normal vision. This angle is considered as a solid one of approximately seventy degrees. A fairly uniform distribution of intensity should be sought, and a variation of maximum to minimum, from ten to one, is given as a sufficiently broad limit.

Diffusion is desired for two reasons. First: Aggravating sharp shadows are eliminated. Second: The direct rays from light sources do not prove annoying to residents, especially on narrow streets. High intrinsic brilliancy produces much the same effect as a very low intensity, in that the pupil of the eye contracts, allowing only a small portion of the light to enter the eye. Under this condition perfect vision is impossible. The use of proper

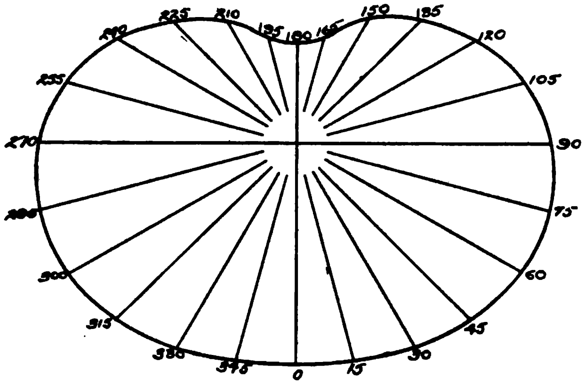


Ornamental Lighting on Michigan Avenue, Chicago, Day

diffusing glassware reduces this objection to a minimum, and although the efficiency is reduced, the result is much more satisfactory.

The varying intensities of illumination produced by flickering street lighting sources are objectionable, due to the fact that the eye must constantly adjust itself. This variation is considerably greater out of doors, where reflection from white walls does not assist in maintaining a fairly constant intensity.

Before entering into the discussion of the various classes of street lighting, your committee desires to emphasize certain conditions which have influenced modern street illumination. Foremost of these is the suspension of high candle power sources too close to the street level, without a proper diffusing medium. Past practice, as a whole, has been to mount street lighting sources far too low. Residential property owners complain of sources suspended at such height that their rest at night is disturbed. The directed light into the sleeping rooms necessitates drawing the curtains, thereby destroying the hygienic qualities of quarters otherwise fairly tolerable.



TYPICAL DISTRIBUTION, DIFFUSING GLOBE WITH INCANDESCENT LAMP

A second drawback is the fact that the American public has not yet thought a higher, more serviceable standard of illumination necessary. That the standard of American street lighting is inferior to that of the cities of England and Continental Europe, none who have studied the existing status will contradict. Two reasonable excuses may be offered for our failing: First, that the cost of labor and material is less there than here at home; Second, that there exists a larger population per square mile in these cities than in American cities. Facts are not borne out, however, in our favor, and it remains that we are just awakening to the advantages of a higher standard of street illumination. Third, we lack uniformity and foresight in the choice of the street lighting units. Obsolescence and fixed charges form a considerable percentage of the rate given on street lighting units, and should be considered in choosing an installation.

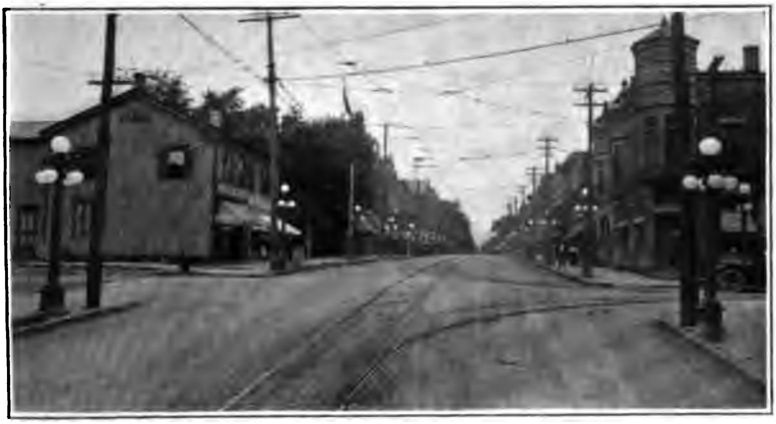
LIGHTING THE BUSINESS DISTRICT

Business district lighting includes such streets as harbor the majority of retail stores, avenues bordering on public squares and highways leading to railroad stations, and certain places of note and distinction. In these districts an average intensity from four to five-tenths (0.4 to 0.5) foot candles is good practice. The ratio of maximum to minimum should not exceed five to one. In addition to the production of a sufficient intensity, a system of illumination should be provided which is ornamental, one that appeals to the senses of beauty, harmony and art. The first impression of a transient public is created by the business district. Therefore, commercial lighting of such portion of the city is incomplete without the harmonious application of the extraordinary.

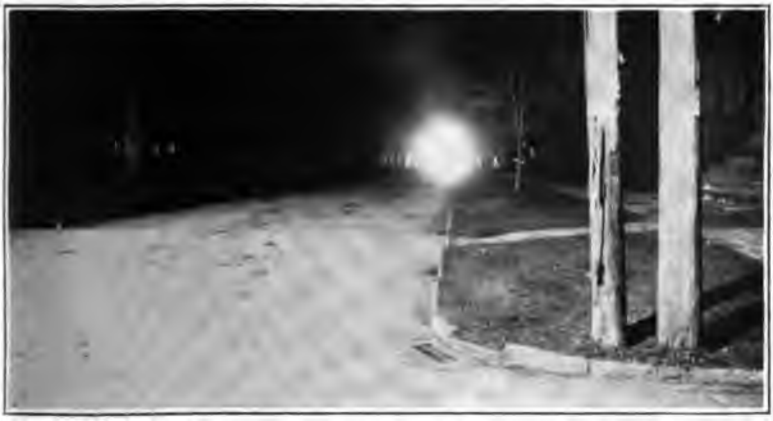
In numerous cities it has been found that abutting properties have been materially improved as street lighting systems have advanced. This, in turn, has increased real estate values, which directly affect the progress of a city.

LIGHTING THE RESIDENCE DISTRICT

Thickly populated portions of the city, cross streets and avenues removed from the business quarters are the sections included. Congestion in such sections is not great, being confined almost wholly to the traffic of pleasure seekers. A low even intensity averaging from one-tenth (0.1) to two-tenths (0.2) foot candles proves satisfactory. High candle power sources are impractical when spaced at great intervals on wooded streets. They become markers of street intersections, instead of producing illumination. The area beneath the unit is very bright, shading off

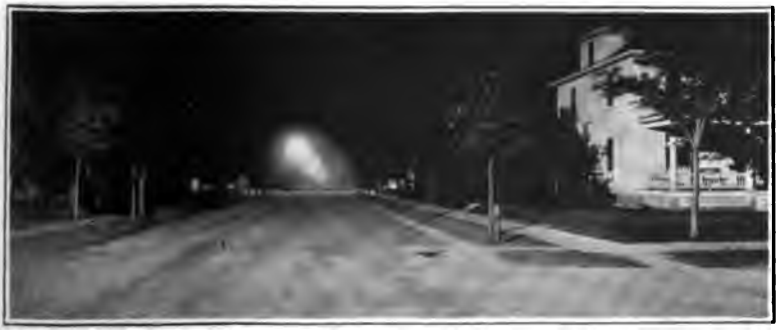


Ornamental Standards at Niles, O.



Arc Lamps as Markers for Street Intersections

Note falling off of intensity between units.



Typical Good Arc Lighting in Residence District

in intensity to an impractical value between units. To obtain maximum returns in lighting, it is necessary that the distribution of light come below the canopy of the surrounding foliage.

It is the concensus of opinion of your committee that small units, placed at shorter intervals and beneath the foliage of trees, produces a more satisfactory arrangement for this lighting service.

The points brought up in connection with the residence lighting apply equally well to suburban lighting. The units, however, may be mounted at a greater height, and consequently at a proportionately greater distance. The intensity is somewhat lower than that suggested for residence districts.

The lighting of public parks and drives is generally not very easy of accomplishment. In addition to the low hanging foliage, the topography of the land is very irregular. Definite rules are impossible, as irregularities prevail. While it is very fitting that ornamentation be considered in this class of lighting, the function which a suitable system must perform should not be overlooked, viz: the production of adequate illumination.

Around winding boulevards and drives, particular attention should be given to the placing of units. Curves should stand out clearly and advantage be taken of the contrast by shadow or "silhouette" principle of viewing objects at night. Unless care be taken in this regard, the image produced in the eye by a light source improperly located, may be so intense as compared with that produced by other objects, that the windings of the driveway are totally obscured. Sources should be invariably on the inside of curves. The driver of a vehicle is therefore looking away from the light, and vision is much more distinct. Vehicles coming to the top of a hill where the units are placed on the outside of the curve, have a tendency to edge in from the lights. The result is frequent collision or narrow escape with down-coming vehicles. An ideal arrangement would include the location of light sources on the inside of the curve, with a white fence flanking the outside. Resulting from poor illumination of parkways are many accidents which could well be avoided. The accompanying picture illustrates the bad combinations liable to arise from staggered boulevard lighting. At this particular place one unfamiliar with the road would imagine it to be straight, and endeavor to cross the gardens and grass plots, instead of keeping to the road.

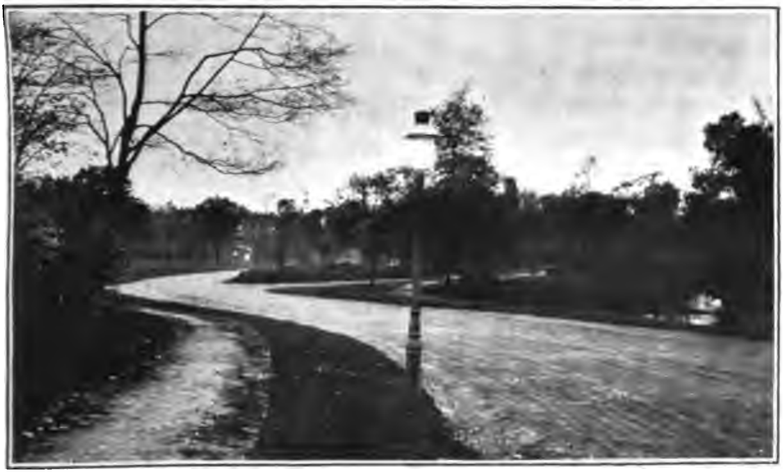
STREET LIGHTING WITH INCANDESCENT LAMPS

Ornamental lighting in the business district

Your committee, upon investigating ornamental lighting in the business district, found the following existing conditions: Multiple 110-volt distribution has proven to be the most satisfactory. The standards, as a rule, are one of three materials: cast iron, pressed metal or concrete. Some of the designs in the last are very unique and serviceable, and they have the added advantage of being produced at a reasonable price by a municipality. The four and five-light standards are the types used most generally. Three light standards are used in the smaller towns between blocks, with five-light standards at intersections. In average cities, or in larger cities where merchants have installed a commercial lighting system, four-light posts are found. Five-light standards are found in the large cities, where commercial street lighting comes wholly or partially under the municipal government. Your committee has noticed eight of these clusters arranged at street intersections in some of the larger towns, one located at the intersection of each building and curb line. This arrangement is very attractive and at the same time raises the intensity of illumination at street intersections, where it is necessary. Much disturbance caused by trolley and telegraph posts located at the position desired for a standard is eliminated in the majority of cases. A certain tendency is noticed toward the installation of one-light standards using high wattage Mazda lamps. We believe that such installations are effective, and produce results similar to those obtained with more than one lamp per standard. They are considered as more artistic and harmonious by many.

The usual mounting height averages about 13 feet 6 inches to the middle of the top globe. This mounting height your committee believes to be somewhat low. The tendency should be to raise the standard so that the bottom of the pendent globes will be approximately twelve feet over the street surface. This recommendation applies only to streets of average width, and where standards are spaced an average distance. The mounting height should be proportionately greater on very wide streets, or streets where the spacing is increased greatly over that recommended.

Your committee has found that in a large number of towns



DECEPTIVE ARRANGEMENT OF LIGHTS ON CURVES
Lights give appearance at night that roadway is straight.

ORNAMENTAL LIGHTING, MICHIGAN AVENUE, NIGHT

it is the practice to extinguish the pendent lamps about midnight, allowing the top one to burn until sunrise. This is accomplished by using a three-wire system of distribution, so arranged that the midnight and all-night lamps are extinguished by separate switches.

The spacing of standards should average between 60 and 80 feet. In other words, the spacing recommended is from five to six times the mounting height of the lamps. We have found this to be the most prevalent, and the results obtained have been satisfying.

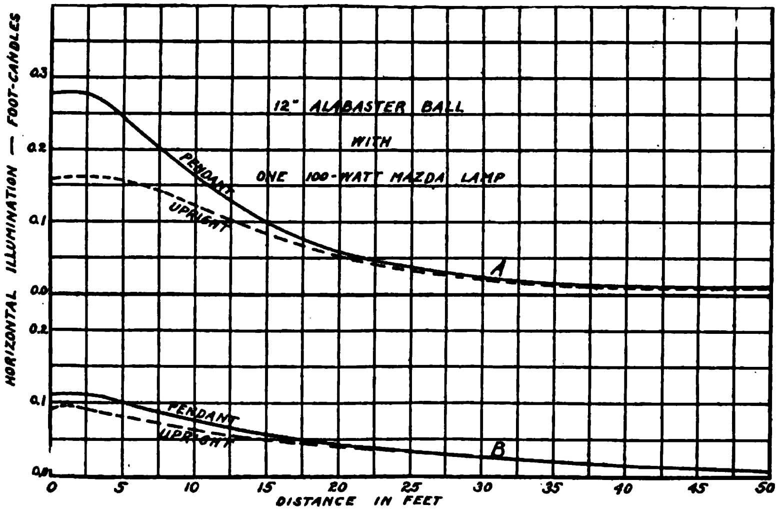
The equipment most generally used on standards is given in the following table. The density of the diffusing globe should be such that the filament of the lamp cannot be seen through the globe. This subduing of the filament is accomplished in some of the alabaster and opalescent globes.

Table of equipment

Standards	Lamp sizes	Globe sizes
One-light	1-250w. 1-400w. 1-500w.	1-14" 1-16" 1-18"
Two-light	2- 60w. 2-100w.	2-12" 2-14"
Three-light	2- 60w. 1-100w. 3-100w.	2-12" 1-14" 3-14"
Four-light	4- 60w. 4-100w.	4-12" 4-14"
Five-light	4- 60w. 1-100w. 5-100w.	4-12" 1-16" 4-14" 1-16"

The question arises—which is the better on ornamental standards, pendent or upright globes? Your committee does not wish to determine this for you, but gives the followng statements. From an engineering point of view, the most uniform illumination is the most satisfactory. By having globes upright, a more uniform illumination is obtained. The intensity directly under the standard is not as high, and that resulting between standards is practically the same, as shown on the accompanying curves. If it is the desire to obtain a high average intensity, globes turned downward increase the total amount of light directed toward the street surface about 30 per cent.

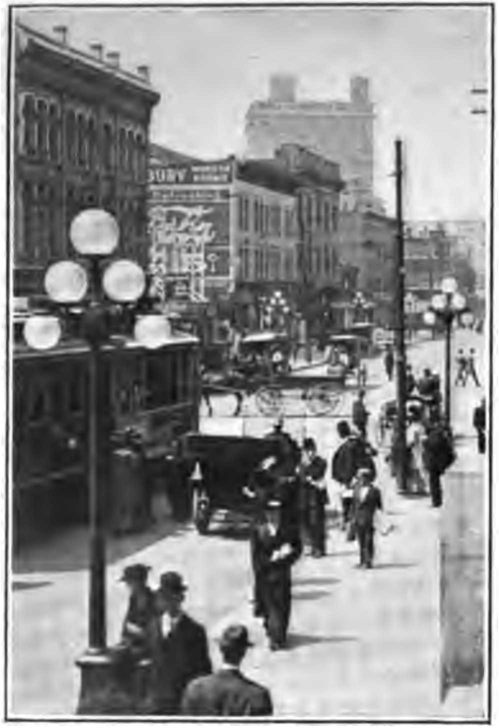
Construction is a matter governed greatly by local conditions. Standards are usually anchored to a concrete cube about 2 feet on a side. The feeders are placed either underground or overhead, the most satisfactory being the former. The underground construction is done in one of three ways: First, by the use of steel armored cable, placed in a trench and covered with an envelope of concrete for protection (in case this is not desired, merely covered with sand); Second, iron conduit is used, into which rubber covered wire is pulled; Third, by the use of fibre or clay conduit with lead-covered cable.



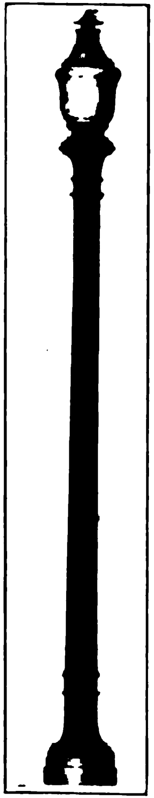
CURVES SHOWING DISTRIBUTION WITH UPRIGHT AND PENDENT GLOBES

Illumination from One 100-Watt Mazda Lamp with 12-inch Alabaster Ball 14 feet above the Street Surface. Curve A, Illumination along Line of Posts. Curve B, Illumination along a Line 14 feet out from Line of Posts.

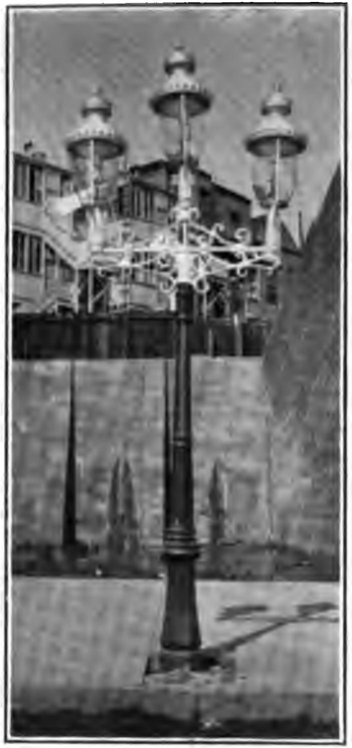
The first system has the objection of high cost of repairs, due to the fact that trouble is hard to locate, and when located is expensive to remedy. The use of armored cable is not to be discouraged, however, and is preferable to iron conduit. The second deteriorates greatly, and in the course of ten years is practically unfitted for service. The last named method, although most expensive, is the most flexible and the most easily handled.



Ornamental Standards, Seattle



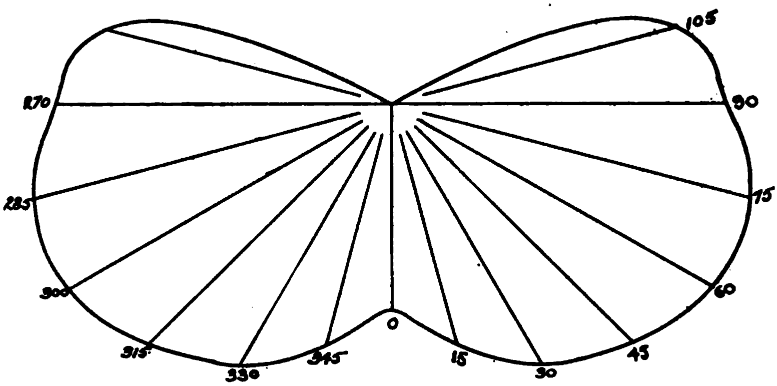
Baltimore
Luminous Arc
Standard



Topheavy Gas Standard

Lighting in the residential and suburban districts

Series distribution in these sections is universal and the 6.6 ampere lamp is usually recommended. The units are suspended either from poles supplied expressly for the purpose, or from telegraph poles. The mounting height recommended is from 12 to 14 feet. But the distance is limited by the surrounding foliage, and to obtain the maximum throw of light the units must necessarily be placed below any foliage obstruction. In wide open areas it may be desirable, in consideration of wider spacing, to mount units as high as 16 feet, in order to receive the benefit of a wider throw from the unit.



Distribution of Candle Power from Incandescent Lamp and Steel Reflector

Units may be spaced in a single line, suspended along either the center of the street or along one side of the street from mast arms secured to telegraph poles or poles specially located. They may be located also according to a staggered system in which case they advance alternately one-half of the distance chosen between standards on one side. A spacing of 125 feet lengthwise of the street may be given for the single line arrangement, and 150 feet if staggered (300 feet on a side). Sixty, eighty, or one hundred candle power lamps are used, according to the nature and importance of the thoroughfare. The most prevalent are the eighty candle power.

Single line center suspension lighting compares unfavorably with single line side suspension lighting on account of the numerous law suits and claims which are registered from contact with high tension. The leads to the lamp are long and at times are liable to become detached and fall to the ground. The system also lends itself less to pleasing construction.

In suburban districts, the same arrangements of units are accepted. A lower intensity proves satisfactory, which may be obtained either by increasing the spacing with the same size of lamps, or by using smaller candle power lamps, with the same recommended spacing. It is recommended to install as small units as is practicable, and group these as closely as is compatible with construction costs. Obviously the smaller the unit the closer they must be spaced.

Lighting of public parks, drives and boulevards

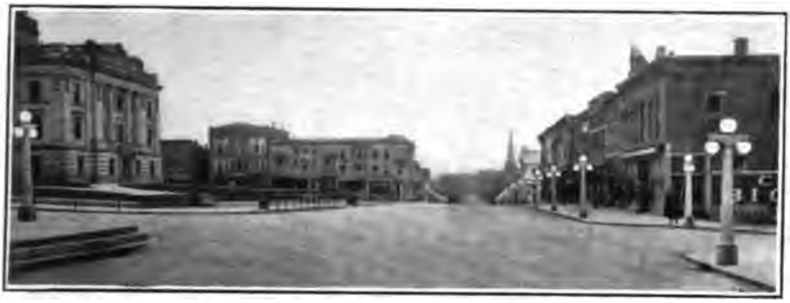
Although either of the systems named for the previous classes of lighting may be used in park lighting, something ornamental harmonizes better with the surroundings. Therefore a lantern standard of some pleasing design, or a single ornamental standard holding an upright globe is found to be the most generally used.

The mounting height of standards should be as great as possible, especially on drives and boulevards, in order that they may be out of the line of vision and also that the difference between a hole in the pavement and an obstruction may be distinguished. If units are placed low, the casting of long shadows makes it impossible to detect this difference.

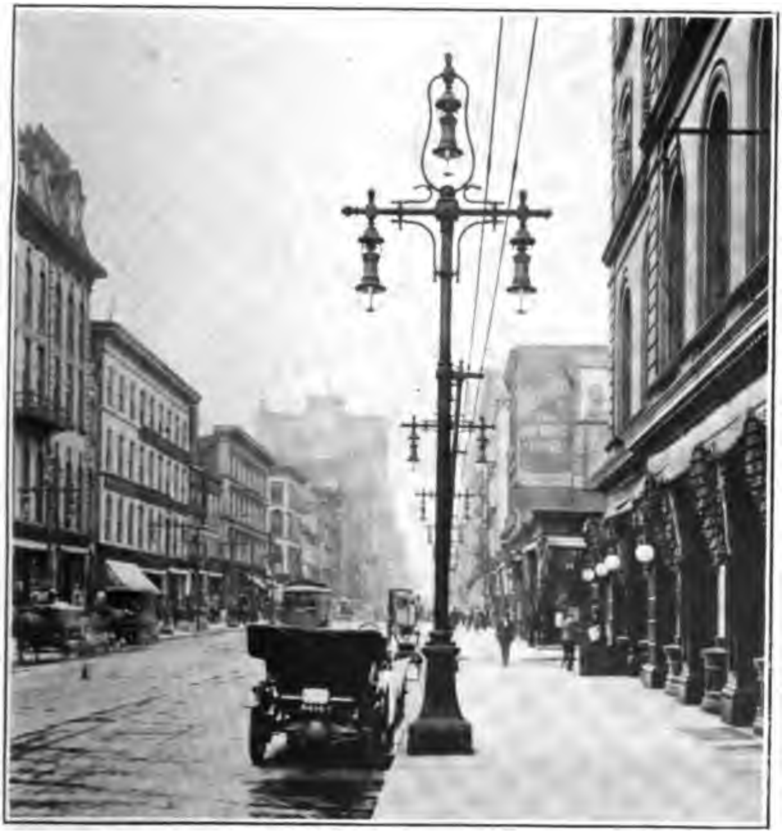
No rules can be specified as to location of standards except as given in the general discussion. The topography of the land determines, to a great extent, the spacing and design of the lighting system.

Underground distribution is to be recommended in parks and boulevards, as overhead wiring tends to spoil the effect created by an ornamental installation.

In a park installation the cost of conduit or a concrete envelope is rather high. For this reason steel armored cable merely laid in a trench is used. This construction gives an installation of moderate cost, and one which has been found, in our investigations, to be entirely satisfactory.



Concrete Standards at Bloomington, Ind.



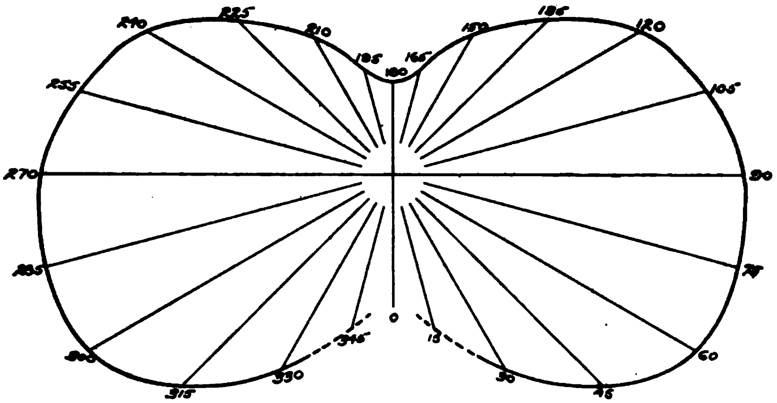
Ornamental Arc Lamp Post which is Detrimental to the Business District

STREET LIGHTING WITH ARC LAMPS

Ornamental lighting in the business district

As before stated, your committee believes that lighting of the business district should be out of the ordinary. Embodying this idea, various combinations of arc lamps on poles have been brought out. Some of these designs we believe to be more detrimental than helpful in creating a pleasing impression.

There has been developed lately an ornamental magnetite arc lamp placed upon a standard for boulevard and business district lighting. Standards used in connection with these arc lamps are of the materials as given for incandescent clusters. The mounting height to the center of the globe is approximately 14½ feet. This height, we believe, should approximate twenty feet with a spacing of from 100 to 150 feet. On very narrow streets a system of this kind is not to be recommended, as the intensity and glare produced is prohibitive. If the standards were placed far enough apart to give the desired intensity, the installation would be awkward.



Typical Distribution, Ornamental, Magnetite Arc Lamp

The arc itself consists of the regular magnetite lamp with the operating mechanism inverted. The globe is of dense opal glass artistically formed, which tends to distribute and diffuse the light properly. The maximum candle power from this lamp is given at about thirty degrees below the horizontal. It operates on a constant current D. C. circuit of 6.6 amperes, and is very well adapted for this class of lighting.

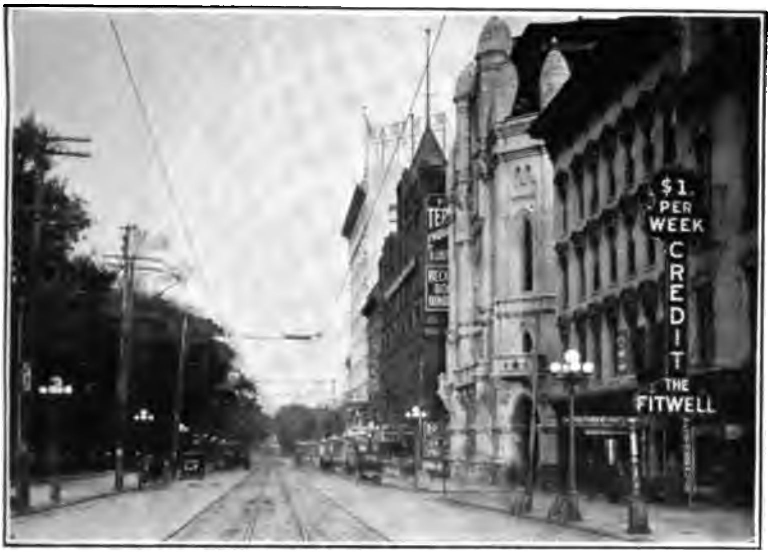
There are a few points, however, which your committee desires to call to your attention. We believe that a high candle power source of such brilliancy should have a somewhat higher mounting height. As the unit is now located, it may be considered as directly in the line of vision. We also believe that an unnecessarily high intensity results from the location of these units, as recommended by manufacturers. This high intensity works to the detriment of the merchants in displaying wares in their show-windows. This type of lighting is also limited to the larger cities, or where large appropriations are available for street lighting purposes. Another objectionable feature of this system is the placing of high tension current underground.

On narrow streets in foreign countries a unique system of street lighting is carried out which enhances the attractiveness and gives to it a very open impressive appearance. This practice consists of suspending arc lamps at some distance from the street level on building fronts. The façades of the buildings, although variable in the nature of construction, reflect a certain portion of the light onto the street level. The combination of the brightness of the building fronts and street level produces a bright commanding appearance.

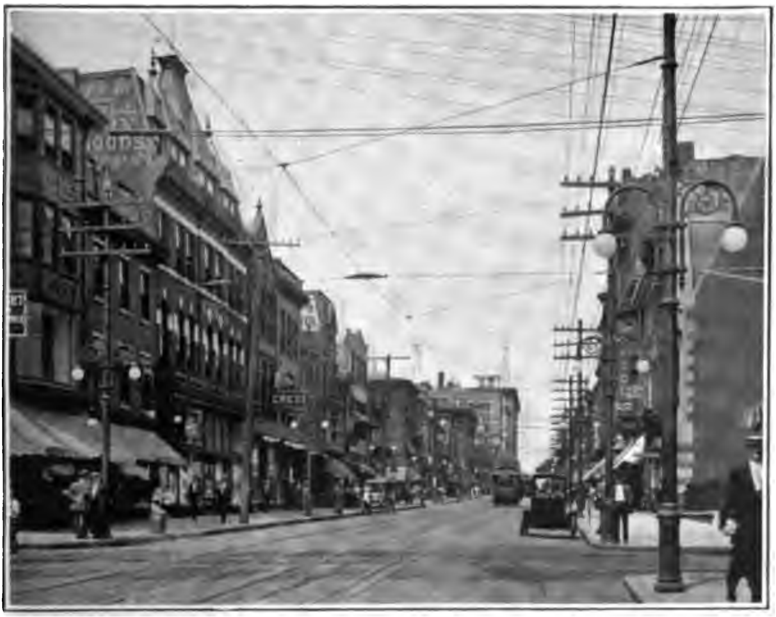
Lighting in the residential district

It is not the intention of your committee to draw comparisons between arc lamps for residential district lighting; but rather to draw comparisons between units as illuminants for street lighting.

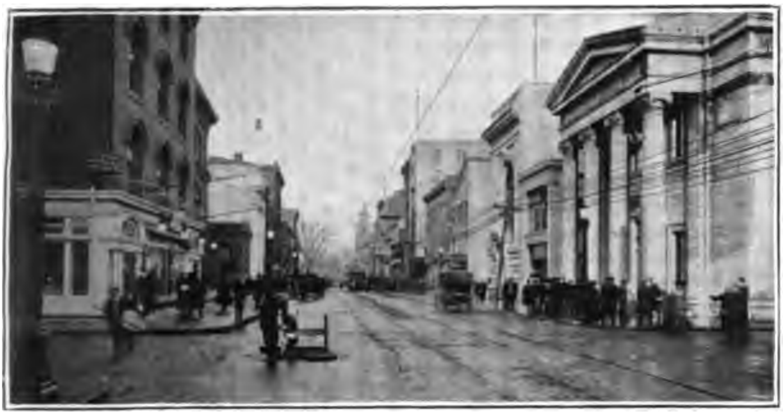
Up to the present time it has been the practice to install arc lamps for the purpose of markers at street intersections, rather than for the successful production of street illumination. To render illumination most effective in these districts, glare should be eliminated and unformity produced. With these requirements, an arc lamp placed at a proper mounting height in relation to the usual spacing of from 350 to 400 feet (an average city block) results in a considerable falling off of intensity between lamps. This decrease of intensity is accentuated by the fact that the



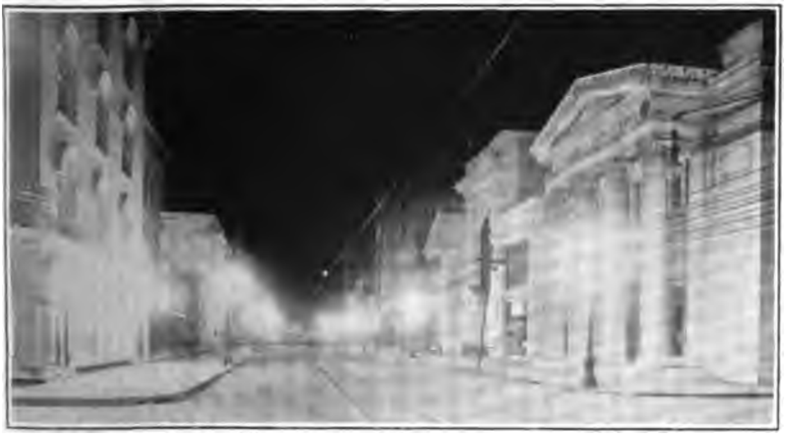
Ornamental Standards, Columbus, O.



Market Street, Looking North from Sixth, Wilmington, Del.



Ornamental Luminous Arc Lamps, New Haven

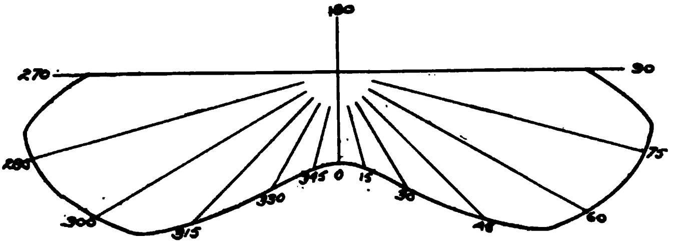


Luminous Arc Lamps at Night, New Haven

majority of residence streets in towns are wooded. The ability to see at the low intensities provided depends largely upon the dark adaptation of the eye. If the lighting varies greatly from point to point, the danger of accidents occuring in the shaded places between lamps is unnecessarily great, because the gloom encountered is exaggerated by contrast. These requirements, therefore, favor the use of smaller lighting units spaced a relatively shorter distance apart, which practice enables the mounting height to be such that the maximum throw of light from the lamp will be unobstructed.

Lighting the suburban district

In suburban districts or country roads, the highway may or may not be wooded. The fact that an arc lamp is a unit of high cost and high candle power necessitates greater spacing with a consequent decrease of illumination between lamps. If the thoroughfare under these conditions is heavily wooded, the situation is brought to an almost impractical point. Therefore, your committee likewise recommends the use of small units for this division of street lighting.



Typical Distribution, 4.0 Amp. Magnetite Arc Lamp

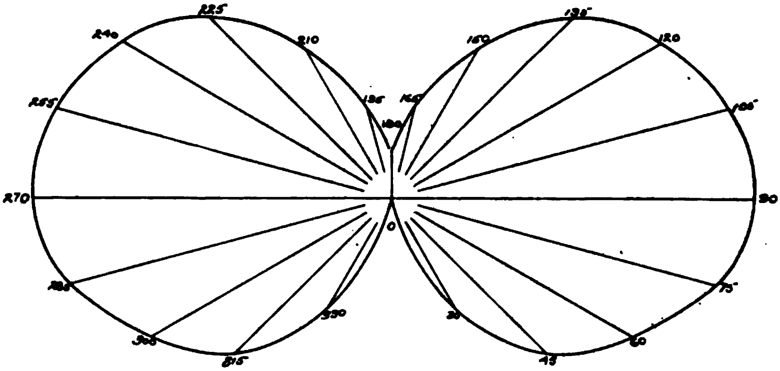
Lighting public parks, drives and boulevards

In lighting public parks, drives and boulevards, conditions similar to those of residence and suburban districts hold true. The problem is more complex, however, for there are found winding drives and irregular ground. For these reasons arc lamps in parks have found but small favor. Your committee favors the use of small units for lighting conditions experienced in parks. On straightaway boulevards, arc lighting has received considerable commendation. The arc lamps are hung at considerable height above the roadway, 25 to 30 feet, which suspension distributes a fairly uniform intensity devoid of sharp, long shadows and of ample value.

STREET LIGHTING WITH GAS LAMPS

Ornamental lighting in the business district

Up to within a few years ornamental lighting in the business district consisted of two, three or more gas arcs, utilizing upright mantles. These arcs were mounted on standards which appeared



Typical Distribution, Upright Gas Mantle

very awkward and top-heavy. The development of the inverted mantle has brought about the ornamental gas standards, which in appearance are similar to the incandesent clusters already mentioned. Your committee desires to draw attention to a number of facts concerning the ornamental system of gas lighting.

The illumination produced is very pleasing and as a decorative feature the designs harmonize well. The distribution of the light flux, however, is decidedly downward and produces spot-lighting at the standard. Inconvenience is also a matter for consideration. The fact that each lamp must be lighted separately means stained, unsightly globes, and breakage. Automatic lighting by pressure gas waves has been experimented with, but its development is not

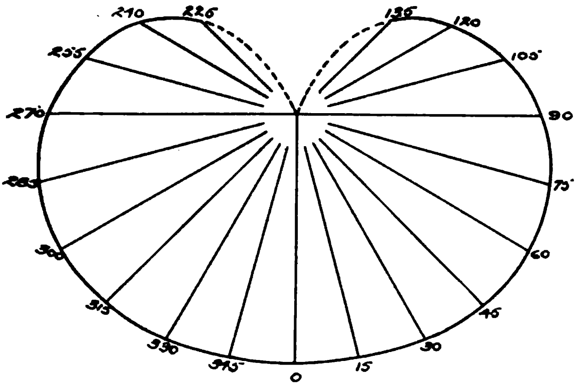
SPOT LIGHTING WITH ORNAMENTAL GAS LIGHTING

ORNAMENTAL STANDARDS AT PUEBLO, MEXICO

perfected. These lamps are subject to the same criticism as are single lighting units in the residence district, viz., the candle power of the mantles is a variable quantity, and in reviewing tests which have been carried on, we find the average candle power produced to be much less than the rated candle power. Ornamental gas lighting is somewat uncertain and the satisfactory operation a matter of experience.

Lighting the residence district

The main objections to the lighting of residence districts with upright gas mantles are the uncertainty of the candle power produced, the number of outages and the lack of convenience. Here also, each lamp must be lighted separately. The candle power distribution from the lamp is not ideal in that the maximum candle power is directed horizontally. Much of the light therefore is wasted in lighting the surrounding trees and foliage.



TYPICAL DISTRIBUTION, 3-MANTLE GAS ARC WITH DIFFUSING GLOBE

Lighting the suburban district, parks, boulevards, etc.

In the lighting of suburban districts and parks, we find that the gasoline vapor lamp is used quite extensively. Its position is that of a substitute for gas or electricity until it is possible with further extension to use such service. The mantle used is similar to the upright mantles of ordinary gas standards and the same objections are pertinent. The vapor units are usually located in open places, where air currents materially affect the mantle. The results are flickering, broken mantles and low candle power.

RÉSUMÉ

In the foregoing we have in no manner endeavored to make a comparison of illuminants as to operation, maintenance, etc. We have merely suggested certain points which, in contemplating a lighting system, it might be well, from our investigation, to bear in mind.

We trust that the information included in this report may serve the purpose for which it was presented, namely, that it will aid in raising the present standard of municipal street lighting throughout the United States.

D. A. HEGARTY, *Chairman,*
W. A. VON PHUL,
W. C. BRENNAN.

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FILL OVER COMPLETED SEWER

REPORT OF THE COMMITTEE ON MUNICIPAL LEGISLATION AND FINANCE

The committee has undertaken, with the aid of the Society clearing house, a general study of what has been done in the field of municipal legislation during 1912 that was new or novel or of special interest, and in response to circular letters to governors and mayors of all cities of over 5000 population has accumulated a large number of city charters and considerable information on the subject. While the number of replies received is much less than the inquiries sent, yet they came from all parts of the Union, representing thirty-five states, and taken as a whole are fairly representative of general conditions in this field. The circular letters asked particularly as to the form of government in operation, and if any new or novel features had been introduced within the past year, whether the present form of government was satisfactory, and whether any new or improved methods of finance were in use.

Without exception the replies indicate no new or novel methods of finance in use or proposed, which is quite surprising in view of the generally recognized fact that there is such a wide field for improvement in the methods of organizing and administering financial departments in municipalities. This seems to indicate the necessity for some organized effort on the part of the city officials and others interested, to improve and, so far as possible, standardize the organization and administration of municipal financial affairs. The advisability of undertaking this work as a special feature by a special committee, in conjunction with the standing or other special committees whose work may be of assistance, is submitted for the consideration of the society.

The replies to the question of whether the form of government in use was satisfactory, with one or two exceptions, indicate entire satisfaction; but in drawing conclusions from this it must be remembered that all the answers came from officials of the party in power and would naturally be more partisan than judicial.

The replies from governors give a better indication of general conditions, though many of these also reflect partisan opinions or personal bias. The most reliable source of information is the results of state and local elections on municipal laws. A study of this field shows that there has been a wide-spread movement among municipalities over the whole Union for amendments or alterations to their present form of government, or for the adoption of entirely new and radically different forms. The general trend of all these changes has been toward concentration of power and responsibility in fewer officials, the general simplification of the organization and administration of municipal affairs, indicating a strong and widespread desire for improved conditions and better results, a desire that is directly due to increasing public interest in the general public welfare consequent upon a better appreciation of the duties and responsibility of citizenship and a general uplifting and advancing of civic standards, which has resulted in a public demand for a higher degree of intelligence and ability in public officials and greater efficiency in the administration of municipal governments. This widespread and earnest desire of the public for improvement and progress in municipal affairs has very naturally resulted in a great variety of forms of governments, because of the widely different state laws and constitutional requirements governing the forms of municipal government. This difference of state laws and constitutional limitations has influenced the result of the movement in various ways.

In some states, where the state laws are explicit and restrictive, and constitutional requirements confined within narrow limits, the result has been to delay the movement until public opinion acquired sufficient momentum to bring about a repeal of these laws and constitutional amendments that would permit an expression of the public sentiment desiring a change; in other states the restraining influence of state laws and constitutional requirements has been only such as to direct the change of forms along certain general lines; while in still others, where the influence of state laws and constitutional requirements is slight, a number of different forms have resulted.

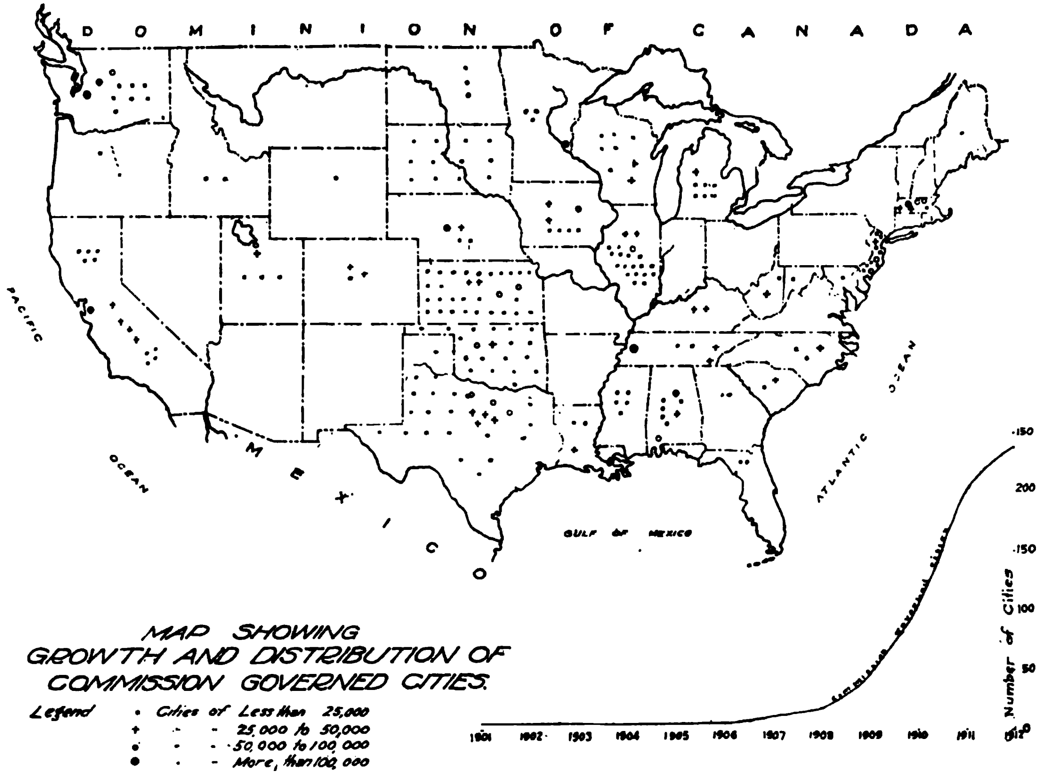
Municipal legislation is of such immediate and vital interest and of such universal importance that a thorough and comprehensive report, doing justice to the whole subject, would require much more time and labor than has been at the disposal of your committee during the past year; they have, therefore, only attempted to select from the data collected such features as are new or novel or of general interest.

Jacksonville, Fla. has a very unusual form of government, composed of a mayor and city council, elected biennially by popular vote, all legislative functions being vested in the council, the mayor having general executive and ex-officio duties, with limited veto power. The city council appoints an executive board of nine members, called the "board of bond trustees," whose term of office is nine years, one term expiring each year. This board has exclusive control of all executive work, except street improvements and the city jail and houses of detention, which duties are executed by a board of public works composed of three members, appointed by the board of bond trustees and confirmed by the city council. The two executive boards control the appointment and organization of all department employees necessary for the execution of their respective duties. The respective duties and powers of the two executive boards overlap each other in such a manner as to suggest the likelihood of a conflict between the two, were it not that one being a creature of the other, conflict is not probable. The natural result of this would be the predominance of the larger creative board over the smaller one. The nine year term of office of the board of trustees is very unusual, and the fact that it is a creature of the city council, serving without pay and not responsible to the public, is not calculated to inspire confidence in the successful fulfilment of its duties. The form has not proved satisfactory and a new charter is now being drawn to be submitted to vote within the next year.

In Virginia, the state constitution fixes the legislative powers of all municipalities in a mayor and bicameral council composed of a board of aldermen and city council, and until comparatively recently the executive powers were vested in various boards and committees; the mayor having general supervisory and veto powers. In 1906 Norfolk adopted, and in 1908 amended, a charter vesting all executive powers in a board of control composed of three members, one of whom is elected biennially by popular vote to serve for six years. This form seems to be giving general satisfaction. Staunton, Va., adopted a variation on the Norfolk plan in 1908, by creating the office of general manager, who is elected annually by the common council, and in whom is vested all executive duties. This is known as the "Staunton plan" and has been widely discussed and commented on, and the state of Oregon has adopted the "general manager" feature or single headed executive department for the government of the state, counties and cities. A bill was presented to the New York legislature in 1911 proposing this form of government for all cities of 50,000 or less. Sumpter, S. C. adopted this form during the past summer. The advantages claimed for it are separation of legislative and executive powers, "single instead of three or five-headed executive branch, avoids confusion of responsibility, and relieves the public of the necessity of judging of a candidate's executive and technical ability." This is the latest distinct form developed and combines essential features of the commission and federal plans of government. The basic idea upon which it is constructed is that municipal affairs should and can be conducted with the same high degree of efficiency that private corporations attain and, therefore, their organization and administration should be as nearly as possible the same.

The plan as developed presents many theoretical advantages over any yet tried, but it lacks the test of time to fully determine its practical possibilities and limitations; therefore conclusions as to its practical value would be premature at present.

The committee has found more activity in commission form of government than any other and has given this especial consideration. The National Short Ballot Organization is advocating the "short ballot" form of government, through its bimonthly bulletin, which has a wide circulation and much influence. We are indebted to the August bulletin for the latest additions to the list of commission governed cities. The National Municipal League is also an influential advocate of commission government and is doing a large amount of work in this field. The accompanying list shows all commission governed cities in the United States, with their population, date of adopting commission form, source of authority of charter, etc. This list is compiled principally from one published in the *Engineeering News* of April 4, 1912, it having been rearranged alphabetically and extended by additions made in 1912. The geographical distribution of the cities and relative size are shown graphically on the accompanying map, on which is also shown graphically the annual rate of increase in the number of cities adopting it:



DISTRIBUTION AND SIZES OF COMMISSION GOVERNED CITIES

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT

Alabama—Total, 9

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Birmingham	1911	1911	132,685
S.L.	*Cordova	1911		1,747
S.L.	*Hartsell	1911		1,374
S.L.B.	*Huntsville	1911		7,611
S.L.B.	*Mobile	1911		51,521
S.L.B.	*Montgomery	1911	1911	38,136
S.	Sheffield	1912		4,865
S.L.	*Talladega	1911		5,854
S.L.	*Tuscaloosa	1911		8,407

California—Total, 14

S.L.B.	†Berkeley	1909	1909	40,434
S.L.B.	†Pasadena	1912		30,291
S.L.B.	†Modesto	1910	1911	4,034
S.L.B.	†Monterey	1910	1911	4,923
S.L.B.	†Oakland	1910	1911	150,174
B.	†Pomona	1911	1911	10,207
L.	†Riverside			15,212
S.L.	†Sacramento	1911		44,696
S.L.B.	†San Diego	1909	1909	39,578
S.L.B.	†San Louis Obispo	1910	1911	5,157
S.L.B.	†Santa Cruz	1911	1911	11,146
S.L.	†Stockton	1911		23,253
S.L.	†Vallejo	1911	1911	11,340
S.	†San Mateo	1912		4,384

Colorado—Total, 4

S.L.B.	†Colorado Springs	1909	1909	29,078
	Durango	1912		4,680
L.B.	†Grand Junction	1909	1909	7,754
L.	†Pueblo	1911		44,395

Florida—Total, 2

L.	Green Cove Springs	1911		1,319
L.	Passagrille	1911		Not given

* State law. † Home rule law.

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT
(Continued)

Georgia—Total, 2

Authority	Place	Date voted	Date in effect	Population
S.L.	*Cartersville	1911		4,067
L.	Marietta	1911		5,945

Illinois—Total, 20

Authority	Place	Date voted	Date in effect	Population
L.	*Braceville	1911	1911	971
S.L.B.	*Carbondale	1911	1911	5,411
S.L.B.	*Clinton	1911	1911	5,165
S.L.B.	*Decatur	1911	1911	31,140
S.L.B.	*Dixon	1911	1911	7,216
S.L.B.	*Elgin	1911	1911	25,976
S.L.	*Forest Park	1911	1911	6,594
S.L.	*Hamilton	1911	1911	1,627
S.L.B.	*Hillsboro	1911	1911	3,424
S.L.B.	*Jacksonville	1911	1911	15,326
S.L.B.	*Kewanee	1911	1911	9,307
S.L.B.	*Moline	1911	1911	24,199
S.L.B.	*Ottawa	1911	1911	9,535
S.L.B.	*Pekin	1911	1911	9,897
S.L.B.	*Rochelle	1911	1911	2,732
S.L.B.	*Rock Island	1911	1911	24,335
S.L.B.	*Springfield	1911	1911	51,678
S.L.B.	*Spring Valley	1911	1911	7,035
S.L.	*Waukegan	1911	1911	16,069
S.	*Harvey	1912	1912	7,227

Iowa—Total, 7

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Burlington	1909	1910	24,324
S.L.B.	*Cedar Rapids	1907	1908	32,811
S.L.B.	*Des Moines	1907	1908	86,368
S.L.B.	*Fort Dodge	1910	1911	15,543
S.L.B.	*Keokuk	1909	1910	14,008
S.L.B.	*Marshalltown	1910	1911	13,374
S.L.B.	*Sioux City	1910	1910	47,828

Idaho—Total, 2

Authority	Place	Date voted	Date in effect	Population
L.	Boise			17,358
S.L.B.	‡Lewistown	1907	1907	6,043

* State law. ‡ Charter.

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT (Continued)

Kansas—Total, 31

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Abilene	1910	1910	4,118
S.L.B.	*Anthony	1909	1909	2,669
S.L.B.	*Caldwell	1909	1909	2,205
S.L.	*Chanute	1911		9,272
S.L.B.	*Cherryvale	1910	1911	4,304
S.L.B.	*Coffeyville	1909	1910	12,687
S.L.B.	Council Grove	1911	1911	2,545
S.L.B.	Dodge City	1910	1911	3,214
S.L.B.	*Emporia	1910	1910	9,058
S.L.B.	Eureka	1910	1910	2,333
S.L.B.	*Girard	1910	1910	2,446
S.L.B.	*Hutchinson	1909	1909	16,364
S.L.B.	*Independence	1909	1909	10,480
S.L.B.	*Iola	1910	1910	9,032
S.L.B.	*Kansas City	1909	1910	82,331
S.L.B.	*Leavenworth	1908	1908	19,363
S.L.	*Manhattan	1911		5,722
S.L.B.	*Marion	1910	1910	1,841
S.L.B.	*Neodosha	1910	1911	2,872
S.L.B.	*Newton	1910	1910	7,862
S.L.B.	*Parsons	1909	1910	12,463
S.L.B.	*Pittsburgh	1910	1910	14,755
S.L.	*Pratt	1911		3,302
S.L.B.	*Topeka	1909	1910	43,684
S.L.B.	*Wellington	1910	1910	7,034
S.L.B.	*Wichita	1909	1909	52,450
S.	Arkansas City	1912		7,508
S.	Holton	1912		2,842
S.	Portage	1812		5,440
S.	Rice Lake	1912		3,968
S.	Superior	1912		40,384

Kentucky—Total, 2

Authority	Place	Date voted	Date in effect	Population
S.L.	Lexington	1911	1912	35,099
S.L.B.	*Newport	1910		30,309

Louisiana—Total, 4

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*New Orleans	1912	1913	339,075
	*Shreveport	1910	1910	28,015
	New Ibera	1912	1912	7,400
	Natchetoches	1912	1912	2,582

* State law.

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT
(Continued)

Maine—Total, 1

Authority	Place	Date voted	Date in effect	Population
S.L.	Gardiner	1911		5,311

Massachusetts—Total, 6

Authority	Place	Date voted	Date in effect	Population
S.L.B.	‡Gloucester	1908		24,398
S.L.B.	‡Haverhill	1909		44,115
S.L.	‡Lawrence	1911		85,892
S.L.	‡Lowell	1911		106,294
S.L.B.	‡Lynn	1910		89,336
S.L.	‡Taunton	1909		34,259

Maryland—Total, 1

Authority	Place	Date voted	Date in effect	Population
S.L.B.	Cumberland	1910	1910	21,839

Mississippi—Total, 5

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Clarksdale	1910	1911	4,079
S.L.	*Gulfport	1911		6,386
S.L.B.	*Hattiesburg	1910	1911	11,733
S	*Laurel	1911(?)		8,465
S.	Meridian	1912		23,285

Michigan—Total, 7

Authority	Place	Date voted	Date in effect	Population
L	†East Jordan	1911		2,516
L.	†Flint			38,550
L.	Fremont	1911		2,009
S.L.B.	†Harbor Beach	1910	1910	1,556
S.L.B.	†Pontiac	1911	1911	14,532
S.L.B.	‡Port Huron	1910	1911	18,863
S.L.B.	Wyandotte	1911	1911	8,287

Minnesota—Total, 4

Authority	Place	Date voted	Date in effect	Population
S.L.B.	†Faribault	1911	1911	9.001
S.L.B.	†Mankato	1910	1910	10,365
S.L.	†St. Paul	1812		214,744
S.L.	St. Cloud	1911		10,600

*State law. † Home rule law. ‡ Charter.

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT
(Continued)

New Jersey—Total, 11

Authority	Place	Date voted	Date in effect	Population
L.B.	*Hawthorne	1911	1911	3,400
L.	*Irvington	1911	1911	11,877
L.B.	*Margate City	1911	1911	129
S.L.	*Ocean City	1911	1911	1,950
S.L.B.	*Passaic	1911	1911	54,773
S.L.	*Ridgewood	1911	1911	5,416
S.L.B.	*Trenton	1911	1911	98,815
S.	Atlantic City	1912		46,150
S.	Long Branch	1912	1912	13,298
S.	Nutley	1912		6,009
S.	Ridgefield Park	1912		

North Carolina—Total, 3

S.L.B.	‡Greensboro	1911	1911	15,895
S.L.B.	‡High Point	1909	1909	9,525
S.L.B.	‡Wilmington	1911	1911	25,748

Nebraska—Total, 4

S.L.	Beatrice	1911		9,356
S.L.	*Omaha	1911		124,096
S.	Nebraska City	1912		5,488
S.	Lincoln	1912		43,973

North Dakota—Total, 3

S.L.B.	*Bismarck	1909	1909	5,443
S.L.B.	*Mandan	1907	1907	3,873
S.L.B.	*Minot	1909	1909	6,188

New Mexico—Total, 1

S.L.	*Roswell	1910		6,172

Montana—Total, 1

S.L.B.	*Missoula	1911	1911	12,869

* State law. † Home rule law. ‡ Charter.

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT
(Continued)

Oklahoma—Total, 20

Authority	Place	Date voted	Date in effect	Population
S.L.B.	†Ardmore	1908	1909	8,618
S.L.B.	†Bartlesville	1910	1910	6,181
S.L.B.	†Duncan	1910	1910	2,447
S.L.B.	†Enid	1909	1909	13,799
S.L.B.	†El Reno	1910	1911	7,872
S.L.B.	†Guthrie	1911	1911	11,654
S. L.	†Holdenville	1911		2,296
S.L.	†Lawton	1911		7,788
S.L.B.	†McAlister	1910	1910	12,954
S.L.B.	†Miami	1910	1910	2,907
S.L.B.	†Muskogee	1910	1911	25,278
S.L.B.	†Oklahoma City	1911	1911	64,205
S.L.B.	†Purcell	1910	1911	2,740
S.L.B.	†Sapulpa	1910	1910	8,283
L.	†Stillwater	1911		3,444
S.L.B.	†Tulsa	1908	1909	18,182
S.L.B.	†Wagoner	1910	1911	4,018
S.	Ada	1912		4,309
S.	Duvant	1912		5,330
S.	Okmulgee	1911		4,176

Oregon—Total, 1

Authority	Place	Date voted	Date in effect	Population
S.L.B.	Baker City	1910	1910	6,742

South Carolina—Total, 2

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Columbia	1910	1910	26,319
S.	§Sumpter	1912		8,109

South Dakota—Total, 12

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Aberdeen	1911	1911	10,753
S.	*Canton			2,103
S.L.B.	*Chamberlain	1910	1910	1,275
S.L.B.	*Dell Rapids	1910	1910	1,367
S.L.B.	*Huron	1910	1910	5,791
S.L.	*Lead	1911		8,392
S.L.B.	*Pierre	1910	1910	3,656
S.L.B.	*Rapid City	1910	1910	3,854
S.L.B.	*Sioux Falls	1908	1909	14,094
S.L.B.	*Vermillion	1910	1910	2,187
S.L.B.	*Yankton	1910	1910	3,787
S.	*Madison	1912		3,137

*State law. †Home rule law. §City manager.

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT
(Continued)

Tennessee—Total, 5

Authority	Place	Date voted	Date in effect	Population
S.L.B	‡Chattanooga	1911		44,604
L.	Etowah			1,685
S.L.	‡Knoxville	1911	1912	36,346
S.L.B.	‡Memphis	1909	1910	131,105
L.	‡St. Elmo	1911	1911	2,426

Texas—Total, 28

B.	*Abilene	1911		9,204
S.L.B.	*Arkansas Pass	1910	1910	1,197
S.L.B.	‡Austin	1909	1909	29,860
L.B.	*Barry	1910	1910	Not given
S.L.	Beaumont			20,640
S.L.B.	‡Corpus Christi	1909	1909	8,222
S.L.B.	‡Dallas	1907	1907	92,104
S.L.B.	‡Denison	1907	1907	13,632
L.B.	*Elkhart	1910	1910	Not given
L.B.	*El Paso	1807	1907	39,279
S.L.B.	*Ft. Worth	1907	1907	73,312
S.L.B.	*Galveston	1901	1901	36,981
L.B.	Harlington	1910	1910	Not given
S.L.B.	‡Houston	1905	1905	78,800
S.L.B.	*Kennedy	1910	1910	1,147
L.B.	*Lyford	1910	1910	Not given
B.	*McAllen	1911	1911	Not given
S.B.	*Marble Falls	1910	1910	1,061
S.L.B.	‡Marshall	1909	1909	11,452
L.	Orange			5,527
S.L.B.	‡Palestine	1909	1909	10,482
S.L.	Port Arthur	1911		7,663
S.L.B.	*Port Lavaca	1910	1909	1,699
B.	*San Benito	1911	1911	Not given
L.B.	Spur	1911		Not given
L.	Sherman			12,412
B.	*Terrell	1910	1911	7,050
L.B.	‡Waco	1909	1909	26,425

* State law. ‡ Charter.

TABLE SHOWING CITIES WHICH HAVE COMMISSION FORM OF GOVERNMENT
(Continued)

Utah—Total, 5

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Logan	1911		7,552
S.L.B.	*Murray	1911		4,057
S.L.B.	*Ogden	1911		25,580
S.L.B.	*Provo	1911		8,925
S.L.B.	*Salt Lake City	1911		92,777

Wisconsin—Total, 8

Authority	Place	Date voted	Date in effect	Population
S.L.B.	*Appleton	1911	1911	16,773
S.L.B.	*Eau Claire	1910	1910	18,310
S.L.	Oshkosh	1911		33,062
S.	Jonesville	1912		13,894
S.	Menominee	1912		5,036
S.	Portage	1912		5,440
S.	Rice Lake	1912		3,968
S	Superior	1912		40,384

West Virginia—Total, 3

Authority	Place	Date voted	Date in effect	Population
S.L.B.	‡Bluefield	1909	1909	11,188
S.L.B.	‡Huntington	1909	1909	31,161
S.L.B.	Parkersburg	1911	1911	17,842

Wyoming—Total, 1

Authority	Place	Date voted	Date in effect	Population
S.L.B.	Sheridan	1911	1912	8,408

Washington—Total, 10

Authority	Place	Date voted	Date in effect	Population
S.L.	Centralia	1911(?)		7,331
S.L.	Chehalis	1911		4,507
S.L.B.	*Hoquiam	1911	1911	8,171
S.L.	North Yakima	1911		14,082
L.	Olathe	1911		3,000
S.L.B.	Seattle	1912		237,014
S.L.B.	*Spokane	1910	1911	104,402
S.L.B.	Tacoma	1909	1910	83,743
S.L.	Walla Walla	1911		19,364
S.	Everett	1912		2,484

*State law. †Home rule law. ‡Charter.

"Charter" means an act of the legislature, which may or may not have to be ratified by popular vote. "State law" means a general law governing cities in the state, the adoption of which is optional. "Home rule" means that the charter was drawn by a popularly elected charter commission, then submitted to popular vote.

The list comprises a total of 239 cities and towns having a total population of 5,263,733. The annual increase in population adopting this form is as follows:

Year	Increase	Year	Increase
1901	36,891	1907	265,224
1902		1908	162,940
1903		1909	485,724
1904		1910	833,840
1905	78,800	1911	2,125,069
1906		1912	1,178,435

Classified as to size, there is as follows:

	cities
Over 200,000 population	3
100,000 to 200,000 population	6
50,000 to 100,000 population	14
25,000 to 50,000 population	31
10,000 to 25,000 population	48
Less than 10,000 population	137

Of the commission government charters received, that of Sacramento, Cal., is one of the latest and most typical, containing many features that are new and interesting, and to all who are interested in commission government we would recommend this for careful consideration. The following features of this charter are considered worthy of note: The Commission consits of five members, in whom all legislative and executive powers are vested. They are the only elective officers and hold office for five years, one term expiring annually. The executive and administrative powers are divided into five departments as follows: 1, department of public works; 2, department of streets; 3, department of public health and safety; 4, department of education; and 5, department of finance, with one commissioner in charge of each department.

Section 15, under salaries, fixes a minimum wage of $3 per day to be paid for labor employed by the city, which would seem to indicate a strong influence of the local labor element.

Section 33 provides for the summary abatement of nuisances and making the charges a lien upon the property. This might lead to a careful definition of a nuisance as looked at by the court.

Section 40 provides for the removal of weeds, rubbish or dirt from buildings, grounds or sidewalks, making the charges a lien on the property. This ought to stir up local civic pride and a lot of incidental litigation.

Section 41, regulating the use of bill boards and signs on public and private property, ought to be productive of much good from an esthetic standpoint.

Section 60 provides for the fixing and determining by ordinance annually (in February, to take effect in June) of the rates of compensation to be collected by any person, firm or corporation in the city for the use of heat, light, power or telephone service, or other public utility supplied to the city or the inhabitants, and for prescribing the quality of the service; and section 61 provides for the regulation of street and suburban railroads, their tracks and cars, the issuance and exchange of transfers, and for fixing the rates and charges thereon, and for compelling the owners of two or more railroads using the same street to use the same tracks and equitably divide between them the cost of construction and maintenance thereof. It will be quite interesting to learn how these two sections work out practically and what their effect will be on public service corporations.

Section 67 provides for the expenditure of not to exceed two cents on the $100 of assessed valuation for entertainment of public guests, public celebrations, inducing immigration to the city, exhibiting manufactured and other products and for the purposes of advertising the city. Provisions similar to this are included in the charter of a number of commission governed cities. It is characteristic of the progressive movement and seems a desirable feature to have in any city charter.

Under special qualifications of officers, Section 97½ provides that the superintendent of streets shall be a civil engineer of at least five years practical experience, two years of which shall have been devoted to general municipal engineering. This is a decided step in the right direction and if adhered to ought to give excellent results. Section 108 provides for lighting contracts and limits them to a period of one year. This would seem to be an inducement to high prices, unless the competition was sharp.

A public health and sanitary department is provided for under article 7, and the health officer with the department is given unusually broad and sweeping powers to control and regulate all matters of general health and sanitation, specifying "the care, preparation, manufacture and sale of all articles of food or drink or anything used for human consumption;" also the power to seize and destroy condemned articles, and to post at entrances of all buildings where unsanitary or dangerous conditions or practices are found, a notice of such finding, which must be maintained until the conditions are remedied or abated. The right of summary abatement of any and all nuisances within the city limits that are offensive to the "senses" or that are, or threaten to become, if suffered to continue, detrimental to public health. All pools of stagnant water, and all collections of filth, garbage, manure or other substances that are or may become breeding places or food for mosquitoes, flies, rats, or other disease-carrying insects or animals, are declared nuisances, and the cost of abatement by the city after refusal or failure of the owner to pay is made a lien upon the property and foreclosed at once. The exercise of these powers will require cool heads and careful study to avoid continual strife.

Article xxiii, comprising 18 pages and 35 sections, covers the subject of franchises in detail and has the following noteworthy features: All applications for franchises that it is proposed to grant must be advertised for ten days and then let to the highest bidder; a minimum scale being set of 2 per cent of gross annual receipts for the first five years, 4 per cent during the next ten years and 5 per cent during the remainder of the term, which is limited to thirty-five years. All franchises are granted subject to the city's express right to "make all regulations which shall be necessary to secure, in the most ample manner, the safety wellfare and accommodation of the public, and the right to make and enforce all such regulations as shall be reasonably necessary to secure adequate, sufficient and proper service and accommodations for the people, and insure their comfort and convenience." The maintenance of the plant and fixtures at the highest practicable standard of efficiency at all times, is expressly provided for. The right of the city to regulate and prescribe rates, fares, the exchange of transfers, rentals or charges, is expressly set out; also the right of the city to acquire the plant in its entirety, whenever it shall elect to do so, the value of the franchise itself not being included in the valuation. The administration of these rights by the commission in such manner as to do no wrong to the public or the corporations calls for a high degree of executive ability and technical knowledge. The referendum, the recall and the initiative are all included in this charter.

Under the head of Miscellaneous, article xxix provides for the maintennce of a free public employment office, fixes office hours of city employees from 8.30 a.m. to 5 p.m., and makes 8 hours a day labor. The free public employment office should accomplish much good as a preventive for many demands on public charity and ought to prove a useful adjunct to public charities. The fixing by charter of office hours and day's labor seems unusual and suggests the presence of the politician.

We note that Atlanta, Ga.; Florence, Ala.; Yazoo City, Miss.; Globe, Arizona; and Portland, Washington, have voted adversely on commission government during 1912. Ohio has just adopted an amendment to the state constitution allowing home rule for cities, and Virginia has followed with a consititutional amendment of the same kind. Thirty-four states have to date passed laws or charter amendments that will permit commission form of government in cities.

MAURY NICHOLSON, *Chairman*,
W. W. SOUTHGATE,
W. D. HOWE.

DISCUSSION

MR. HAWLEY: It is mentioned that the city of Staunton, Virginia, employed a manager and gave him absolute power over everything. I wonder if we have thought of that plan enough. One man, if you happen to get a good one, would be a better proposition than the politics we find in electing a government of even five or six men. I have relatives in Staunton, and they seem very well satisfied with the one-man government. Could it be applied to towns of the size of one hundred thousand? One man, if he is a good one, can do great work. He must be trained, honest, skilled in his work, but why not one instead of five or six? In Texas we have home rule for cities also.

THE PRESIDENT: That is a good point. Many of us have asked that same question in the last few years regarding the commission form of government, those of us who are used to the old councilmanic form.

THE SECRETARY: In the state of Pennsylvania there is a league known as the League of Third Class Cities. In that state the cities are divided into three classes. I believe there is only one in the first class, and two or three in the second, so the third class cities comprise a large portion of all. That league has instructed a committee to draw up a form of law which they will present to the next legislature, asking the legislature to adopt this law, permitting the cities to adopt just exactly that sort of charter, a charter in which there shall be a city manager for cities that wish a manager instead of the commission form of government. That was adopted almost unanimously by the representatives of those third class cities, and will probably be passed by the legislature next year, permitting them to adopt that form. The chief reason urged for this,—and the advantage applies to the small cities,—is that a small city cannot afford to pay a $3000 or $4000 salary to three or five commissioners, but they can pick out three commissioners who are good administrators, reliable business men, who would not have to give very much time to it, but who could be relied upon to have the interests of the town at heart, and see that things are run right. Then let those men select a man of ability as manager, to whom they could pay an adequate salary of $3000, $4000 or $5000 a year; the three or five commissioners receiving only nominal salaries, because they give little time to it, simply seeing that the manager does his work, a good deal like the directors of a corporation.

MR. CHRIST: We are working under that same system in Grand Rapids. There is a board of public works; five boards appointed by the mayor of five members each; the board of public works and the board of education were the only ones that had general managers. Those boards would employ a general manager. The council had nothing to say about whom they hired, but the charter regulated the price, $4000 a year. The system works well. The commissioners get scarcely anything. I believe if the boards could be appointed by the mayor, and could get good men, and then let them employ a general manager, they would get the best kind of service.

Mr. Ingram: Is the society not going a little too far in this paper? It is valuable information, but is not the society getting a little too deep into politics when it comes to discuss a form of government? I think we should treat the carrying out of improvements, street paving, sanitation, water works, and those matters, rather than take up this question.

The President: I do not know how the society may feel as a body, but as I see it, this paper is very largely a paper for our information as to what is being done, rather than a recommendation that we shall make as to what should be done. We are as much interested in what other cities are doing in a measure, as in what our own cities are doing, and this paper is a source of valuable information. If we were as a society recommending that we ought or ought not to adopt a certain form of government, perhaps it would be going too far—it might be encroaching upon the territory of some of the other organizations.

Mr. Hawley: Is it not a fact that the essence of this association is to utterly eliminate politics and talk from no standpoint except the best possible administration of affairs?

The President. That is true, and that point should be emphasized.

Mr. Parkes: This society does not limit itself to physical improvements. It is the "Society of Municipal Improvements," and I think anything that has to do with improvements along the lines suggested by this paper is of moment to us. I understand that Staunton, Virginia, put a general manager in, for the reason that their charter did not allow anything else. They put him in there under the provision that the city council had the right to elect certain officers named by statute, and certain other officers necessary for the proper discharge of the public business. Every city in Texas, Arkansas, and Missouri, and nearly every city in the United States has the right to elect a city manager any time they want to without amending their charter.

Mr. Anderson: The thought came to me that ultimately it may be a good plan to have one man, but it is a little in advance of what the municipalities at this time may be prepared for. Possibly the commission form may be an intermediate step. Few men, regardless of their experience in commercial affairs, are qualified to take the place of manager of a large city. They may in a small city, but as the city grows its problems become more complex. The requirements for a man suitable to fill that position become very complex, and cities may be ruled in that manner only when the country at large becomes a field from which they may draw those men. The commission form may be a preparatory school for the training of that class of men. The ordinary citizen, business man or professional man, may take hold of one department and administer the affairs of that department very creditably, but I do not think the larger cities are prepared at this time to adopt that system. In other words, we would have to have some sort of civil service or preliminary preparation before the managers would be a success. The one-man rule to my mind is a little in advance of the present time. When the city may determine the qualifications of a man, his record, and what he has been able to accomplish, and judge with some degree of accuracy of what might be his success, then I should think the system would be a success, because it is founded on the proper principles.

Mr. Henderson: There is a reference in that paper to Sacramento, California, in regard to the value of franchise of a public service corporation. If there are any members present who have definite ideas as to how to value the franchise of a public service corporation, I should like to hear that discussed.

Mr. Macartney: If you will get into communication with the commission created by the legislature of the state of Wisconsin, they have a system of valuation of all the public service corporations in the state. They have a commission made up of business men and engineers who value all of them, and have a basis for doing it.

Mr. Nicholson: In answer to Mr. Ingram, I would say it was not the intention of the committee to make any recommendations as to any particular form of government. The paper was intended merely as information to bring out discussion in the society.

Mr. Macallum: Are there any boards of control in those cities of the United States? The reason I ask—in Canada all business, especially financial business, is carried on by a board of control of five men, and they report to the council. Anything they report can be turned back by a majority vote, or referred by a two-thirds vote. So far as the manager of a city is concerned, I think that is a good deal the fault of your politics in the States. Over there the city engineers are appointed by ballot. It makes no difference what the politics is, and it takes two-thirds of the council to vote them out, once they are in. My title is manager of waterworks and city engineer. That means practically everything in the city, so that I am practically manager of the town, but I report to a board of control, and their recommendations go to council. If by chance the board of control has not met with my wishes, I take the matter direct to the council and have it fought out there. If the city engineer is taken out of politics it makes him independent with reference to those matters.

THE CITY "ECONOMIC"

By LOUIS L. TRIBUS, *Consulting Engineer*

The scope of discussion at a convention of a society organized to consider municipal improvements may be almost unlimited; consequently, the writer will, perhaps, be pardoned for touching on several subjects while presenting a paper on city planning.

There are two main topics in the general subject: one, quite popular in recent years, appealing to the esthetic and to civic pride through the development of the so-called "city beautiful;" the other, not perhaps so popular but of greater importance, not yet designated by a short title. We may call it the "city economic." Neither designation, the "city beautiful" nor the "city economic" is correct, if we wish to hold to pure grammar; but anything is allowable in assigning a catch title.

Some would have us think that the "city beautiful" is a development of recent years—recent years being taken as the last fifty or so. Exploration work, however, much of it examined by the writer, in Egypt, Syria, Asia Minor, Greece, Crete and Italy not only suggests but proves that two, three, four and five thousand years ago there was a development of the "city beautiful" idea, besides which the fondest dreams of landscape architects and engineers today are almost insignificant; civic centers providing for community business, education and pleasure, on a scale that would stagger the purse holders of the modern city.

It is not to the "city beautiful" that we desire to draw special attention at this time, even though a feature of municipal development worthy of much study and upon which cities of wealth can properly expend great sums of money, but rather to the humbler phases of development.

The "city economic" well deserves the attention of engineers as well as sociologists. It is not sufficient that a city engineer should know how to design a water or sewerage system, or suitable grades for a street, or even suitable lines and widths for the streets, but his studies should reach to the heart of affairs, to the lives of those who live and work in the cities and who pay the bills.

Suitable sanitary structures in which to live are, of course, absolutely essential, but convenient transportation to places of work, without discomfort and unnecessary loss of time or undue expense, is equally important.

The placing of schools, markets, stores and factories and to some extent offices, within easy reach of the people, tends to economy of time, nervous force and working ability.

Education, in its ordinary limit of meaning, is not sufficient, but education of the body, of the eye, of the ear, and of the general intelligence must be provided: Parks, playgrounds, museums, libraries, music and amusement halls are important factors in the regimen of a community.

All time has emphasized the importance of the family as the unit of social life. To secure happiness, therefore, the community must cater to the family life and frown upon the herding of hundreds and thousands into congested districts. Why have these districts grown up in most cities? Simply because the community as a whole has neglected its duty. Some may not agree to this, however; may say that concentration and consolidation is the order of the day and that economy of production is secured through segregation of trades and crowding the workers. No one view, however, is all right and others correspondingly all wrong. It has always been exceedingly difficult to drive people into an adoption of the ideal; that is, the ideal as determined by other minds. There are, however, certain basic principles which probably will be recognized by all.

1. That the worker should be able at the minimum expense of time and money to earn his wage, to raise his family, to enjoy the necessities and privileges of pure light, water, air, etc., and to secure helpful education and recreation, both intellectual and physical. Moral and religious education have not been included, for, given the named essentials, moral uplift will follow without special fostering, and man being naturally a religious creature, given proper conditions of life, will secure necessary satisfaction for such cravings.

2. That the factory, shop or store shall receive supplies and deliver output with economy of transportation and time.

3. That the central civic features, such as public buildings, large parks, waterfront development and specially important and extensive educational, historical and art institutions shall be within easy reach of all portions of the community.

4. That public transportation lines shall be so designed as to deliver to and take from the various lesser centers which will develop in meeting the foregoing conditions, the thousands of people who would seek at times the greater centers, without congestion or discomfort and at equal cost to all.

These outlines suggest to the writer the ideal. They may not so wholly appeal to others. Such a policy would, of course, require that all property owners be called upon to develop their holdings in the interest and for the welfare of the whole community rather than solely for individual profit. This is against ordinary human nature, but the trend of public thought (becoming reflected in judicial decisions) is leading to the view that public, rather than private, interests are of paramount importance.

To that end wise legislation must be secured, if found necessary to limit or protect, and where absolute prohibition of uneconomic development seems impossible, then provision should be made for the granting of special privileges so as to encourage development along the more advisable lines.

The first cost of city planning and the execution of plans for economic development are almost negligible factors as compared with the objects to be obtained—health, comfort, happiness, progress—all without unnecessary waste.

Communities organized under democratic government do not lend themselves to radical action as readily as do those fostered under European paternalism. Frequent change of municipal officials does not foster progressive and continuous execution of pre-arranged and well-considered plans or even their intelligent preparation. Lack of proper coöperation between officials in the same community often results in lack of harmony of development; this, of course, more in the larger cities than in the smaller ones.

What is necessary, therefore, to secure even an approximation of the ideal?

1. Intelligent study by municipal engineers of the economic as well as the physical problems.

2. To educate the community so that it will do two things, (a) place in office men and women who shall study its best welfare, in addition to the laudable function of honestly and efficiently spending the public money, and (b) to give to those officials loyal support, intelligent advice and full coöperation.

The movement, therefore, becomes primarily one of education. Trained men must first prepare themselves for better work. The community must then be taught that full rounded, joyous life and greatest prosperity are intimately associated with and dependent upon better conditions. Of these the average citizen is ignorant, though feeling the lack of something, even considering himself defrauded by that lack by not recognizing with that feeling the further fact of personal responsibility.

There can be no doubt that achieving the ideal would in time redound to the financial advantage of each family, though not so largely to the financial gain of present favored interests.

Among the best known phrases of the present day are, "What will it cost?" "Who pays the freight?" This for communities is just as important a problem as for individuals. A city is to a large extent a socialistic center. There was a time when its public functions were very limited—common schools, the maintenance of highways and a certain amount of police protection sufficed for the public welfare. Now, however, the problems are very complex. The city must provide healthful conditions, the broadest possible education and even cater to pleasures; and it is well, for, properly conducted, much can be done on a large scale for general benefit at a less total cost than were the same things achieved through independent private effort, but it must not be overlooked that the people "pay the freight." Every dollar expended for maintenance and benefit must be provided by the taxpayer, not alone he who owns a certain measure of real estate, but he who in any way expends money within the city limits.

How to provide these moneys becomes a very serious problem. There can be no question that expenditures having no direct continuing value beyond the fiscal year in which made should be included in the annual tax bill. Expenditures for articles purchased or improvements made that have a life extending through a term of years are justly open to three methods of meeting the cost; first, including the whole in the first annual tax levy; second, charging in each succeeding tax levy the proportion of the total cost plus interest charges, as divided by the number of years through which the article or improvement has existence or value; third, issuing municipal bonds for the total cost and including in the tax levy interest and sinking fund payments which, accumulated by the expiration of the period of benefit, will equal a sum sufficient to retire the bonds. In each case, of course, practically immediate payment must be made for the work done, or article purchased, with money provided by use of sinking funds or loans; the third method is by far the most popular; the second has much to commend it, while the first, if the policy was continued through, say a period of fifty years, would actually be the cheapest for the community.

The first is a policy that is being very largely adopted by great private corporations, stockholders recognizing that, though their dividends may be deferred for a time, they are surer for the future if betterments are made from earnings. This policy, of course, could not well be adopted for the most costly improvements, those in the larger cities aggregating, perchance, many millions of dollars; for such, the issuance of long term bonds would seem to be the only possible solution, and with some justice, in deferring part of the expense to succeeding taxpayers who share in the benefit.

The foregoing comments apply, of course, more particularly to improvements having value for the public at large. There are many civic projects that have practical value for only a small portion of a city. It is probably desirable, therefore, that the particular district benefited should meet all of the cost; the real answer ought to be shown in the sales value of property affected. If it can be sold for an increased sum of money equal to the pro rata share in the cost of the improvement, there is no injustice in making the property thus enhanced in value buy such increase by paying the assessment. If, however, the policy was adopted and continued, of making improvements by community tax, and the same class of improvements was carried on throughout succeeding years, then all properties would share through successive tax levies in the cost and burden; some districts undoubtedly getting the benefit of enhanced value before a similar increase reached other portions. Absolute equality can never be secured, however, by any system of payment.

There is much to be said on these questions, but the writer, while not holding strongly to either method, as a general rule, is of the opinion that in small communities the making of all improvements at general expense is a better financial policy than by direct assessment for benefit, while in large cities the problem becoming more complicated and local betterment more marked, direct assessment becomes simpler.

Each of the many problems of city development, whether with the idea of beautifying, or making it more efficient, may well be given expert study and careful discussion, for there are many reasonably different views, all likely to have some merit. Again each community has its own peculiar differences, which require intensive study. Many of the larger cities are populated by people of diverse races, who, in time, will become assimilated into a composite cosmopolitan people, but furnishing in the interim cause for much anxious thought. Their customs and habits are brought from the home lands; their vision is limited; their interests outside of seeking a living are almost nil. They have come from paternalistic communities and in large measure must be treated for a time by similar methods.

But development must not wait wholly for assimilation and education. It remains, therefore, for the engineer and sociologist to plan betterments, convince the people, and if possible execute the projects that shall make for immediate gain, gradually reaching to the ideal.

To do this, the worker must be familiar through travel, observation and study, with places and methods other than the home city and its way. Whether this part of his education should be at public or private cost is of less importance than that the fullest and most intelligent publicity should be given to the information secured.

Heart to heart simple lectures must be given explaining the why, the how, the cost, the benefit.

Much can be done in the schools, but more in the press. It is a poor engineer whose public work is unworthy of frequent notice and description in the daily papers, and it is an incompetent reporter who cannot give educational value in his account of development plans and work done.

In very recent years, there have been held in this country four great general conferences upon "city planning," attended by architects, sociologists, and engineers from which much good will come, but the holders of the purse strings must first be reached through educated demands of voters, guided by the trained engineer.

It is the writer's aim in presenting these notes to urge upon the membership of the American Society of Municipal Improvements, study of these broader features of engineering, and a practice looking to humanitarian as well as physical municipal betterment.

DISCUSSION

MR. ANDERSON. It would seem advisable to have a committee of this association to study financial conditions. It is true that many of us are dealing with physical problems, but back of those are the problems of finance, and without their being solved, we can do little with the physical problems.

MR. NICHOLSON: The absence of any information concerning the finances of the different cities was impressed on me very forcibly. I wrote over four hundred letters and I received about one hundred answers, and while a few mentioned that subject, none gave a suggestion of new methods outlined or proposed, and it seems to me that at least the collection of information from the cities on that subject for submission to the society, and the ultimate working of that information into some form of standard shape or general principles by which the financial administration of cities can be compared, would be a very good thing. It is very difficult to compare one set of city books with another set, and to tell what the basis of the workings of one's financial system is. I have never been able to get information along that line, and I think we should appoint a special committee to collect information on it. The subject of municipal legislation was not brought to my attention until I undertook this report, and I have derived an incalculable amount of benefit simply from collecting those data, and I think any committee that will undertake a similar collection of data on the financial affairs of the city and the methods of conducting the financial affairs will receive great benefit, and the society will in turn receive large benefit from it.

The Secretary: Have we not that in your committee?

Mr. Nicholson: I understand that word "finance" is there, but there is too much matter included to treat it all properly. If one committee treats of legislation, and tries to take in the other too, they would not have much time to treat either one of them. I think it should be given to two committees.

The Secretary: As far as the standardizing of municipal finance is concerned, perhaps we would be duplicating the work being done by one or two organizations, such as the Society of Comptrollers and Accounting Officers, Association of Public Accountants, Metz Fund, etc. There are three or four states that have established uniform accounting. Massachusetts has done a little along this line, and Ohio and Iowa both require municipalities to make reports annually on regular forms to a state commission, which also sends accountants around to see that the cities are carrying out the instructions. While I believe that engineers pay too little account to the finances and government of their towns, and other things not strictly engineering, and that they will stand higher in the community and become broader and draw larger salaries when they can see something besides engineering and take a broader view generally, still I do not think we should go into the establishment of standard forms for keeping financial accounts or looking out for the finances of the city.

REPORT OF THE COMMITTEE ON MUNICIPAL DATA AND STATISTICS

At the last convention of this Society, adopting the recommendations made by your committee in its report, the following motion was duly carried:

> *Moved*, That this convention authorize the secretary to employ the necessary assistants to prepare data and opinions on the existing forms of records in the various cities represented in the society and from this collection of data the secretary prepare forms to be presented for adoption at the next convention. The secretary's compensation for this extra work, and the salaries of his assistants to be paid from the funds of the Society.

A further motion authorized the secretary to expend not more than $750.00 in the work outlined in the first motion.

Believing that the committee on municipal data and statistics had thus been legislated out of existence, you can well imagine the surprise of the chairman of last year's committee when he received notice from the secretary that the president had, in his wisdom, appointed a committee on the same subject for this year. And making matters still worse, he had reappointed the chairman of last year's committee, the very member who had urged against the continuation of such a committee because of the lack of results produced by such appointments in previous years.

Last year's committee reported that it was "convinced that a committee of three, appointed from cities so widely separated that collaboration is impossible except by correspondence, will never produce the desired result unless the chairman takes upon himself an almost herculean task, which may or may not be approved by the following convention."

As a proof that the committee displayed much wisdom in reaching such a conviction, your attention might be called to the fact that the present chairman did not, during the year just passed, take upon himself this "almost herculean task" and neither has this committee any "desired results" to offer.

It would, however, ask your careful consideration of a paper on this subject presented by the secretary in accordance with the instructions given him at the last convention. His report would seem to indicate:

1. The necessity of this work remaining under the personal supervision of one man for several successive years and, owing to the time which he will be compelled to devote to the subject, it appears only just and fair that he should be given a liberal allowance of clerical assistance at the expense of the Society.
2. The difficulty of adopting any set of forms that will meet with the unanimous approval and support of all city officials.
3. The desirability of extensive propaganda concerning the subject and the necessity of educating many city officials up to an appreciation of the value of such standard forms before any results worth while can be obtained.
4. The ever increasing importance of the early adoption of a set of standard forms and a liberal circulation of the same among all city officials connected with municipal improvements, not confining the work to the cities represented in the Society but including all those having a population of 10,000 or over.

Your committee would therefor respectfully recommend the adoption of the suggestion made in the paper presented by the secretary and urge the appointment of a general committee, with sub-committees of experts in each of the several lines following the idea embodied in our committee on standard specifications. It is understood that the chairman of the general committee should be a member willing to serve in that capacity until the adoption by the Society of all the necessary forms, and each sub-committee might appropriately be composed of one expert, these sub-committees together forming a general committee. This would tend to lessen the number of non-working committeemen and probably produce quicker and more beneficial results.

Respectfully submitted,

J. C. HALLOCK, *Chairman*,
A. PRESCOTT FOLWELL,
CHARLES C. BROWN.

STANDARD FORMS FOR MUNICIPAL UTILITIES

By A. PRESCOTT FOLWELL, *Secretary of the Society*

At the convention of 1911 this Society authorized the author to take such action, either individually or in coöperation with the Census Bureau or other bodies, as would seem best adapted to result in an early agreement upon and adoption of standard forms for recording and reporting the operation and physical condition of public utilities, appropriating a considerable sum for this purpose. This paper is in the nature of a report upon what has been done in carrying on this work.

It may be said at the outset that little progress has been made, much to the author's disappointment. He had expected to act to a large extent in coöperation with the Census Bureau, and also to obtain the services as an assistant of one who had made more or less of a study of this subject. But shortly after the convention the funds of the Census Bureau available for this purpose were curtailed, and the official upon whom he had counted for coöperation was drafted to another department of the government; and the assistant whom he had counted upon accepted a position which left him no time or opportunity to devote to this work.

Limited thus to his personal efforts, your secretary began by endeavoring to learn what had stood in the way of the success of previous efforts along the same line. Such efforts were begun first, we believe, in connection with water works, when the New England Water Works Association, twenty-seven years ago, adopted a standard form; which was modified somewhat in 1902, was endorsed by this Society about six years ago, and (with a few minor changes) by the American Water Works Association about two years later. Here we have a form adopted by societies which included in their membership probably the majority of the more prominent officials of the country interested in a class of municipal work which, probably more than any other, has been in the habit of publishing and exchanging annual reports. But this standard form has been actually put into use by only a very small percentage of water works superintendents. We believe that at the present day less than fifty water departments and companies use this form. It is matter of the greatest interest, in connection with the present agitation for standard forms in municipal accounts and for physical records and cost accounting, to learn why this or some other form has not been more generally adopted; since the answer may furnish valuable suggestions concerning the methods to be used—or not to be used—for promoting the use of this or of some better form.

With this idea in view circular letters were sent to several hundred superintendents of water works, asking their opinions on these points, and replies have been received from 170 of them, with additional ones still straggling in. All but seven states of the Union are represented in these replies. (See following page.)

An inspection of the replies indicates two things very clearly—that the great majority of superintendents believe a standard form would be very desirable; and that an even greater number had never heard of the standard form of the New England or American Water Works Association; or if they had, had forgotten about it. Sixty per cent stated definitely that they had never heard of the form (19 per cent of the New England replies coming under this head); while 20 per cent gave this impression without definitely stating so. And only 15 reported using the form.

This latter discovery greatly surprised the writer, considering the hundreds of members belonging to the societies which had adopted it. And these two items of information unquestionably furnished by the investigation seem to indicate that the adoption of uniform forms by any considerable number of cities cannot be secured without the most general and continuous publicity.

The word "continuous" is used, because of the unfortunately too general practise of frequently changing the superintendents and other officials of municipal departments, and every year scores of new ones, comparatively ignorant of the matters of which they are placed in charge, need to be informed.

Such publicity, even combined with a belief by superintendents generally in the desirability of a standard form, will, of course, effect the desired result only if the form proposed meets with general

REASONS GIVEN FOR NOT USING NEW ENGLAND WATER WORKS ASSOCIATION FORM

Compiled from replies to circular letter sent out by the Secretary of the A. S. M. I.

State	Use the form	Ignorance of form	Indifference	Other answers	Standard form thought desirable		
					Yes	No	In doubt
New Hampshire		1					
Vermont.........		1					
Massachusetts....	6	2	2	6	13		1
Rhode Island....	1				1		
Connecticut.....	1	1	1	1	3		
	— 8	— 5	—3	— 7	— 17		— 1
New York.......	2	12		4	13	1	3
New Jersey......		2			1		
Pennsylvania....	1	1		3	3		2
Delaware........	1			1	1		
	— 4	—15		— 8	— 18	—1	— 5
Virginia.........		1		1	2		
North Carolina..		1					
South Carolina..		2		1	3		
Georgia..........		4			3		
Florida..........		2			1		
Alabama.........		1			1		
Mississippi.......	1			1	1		
Louisiana........				1	1		
Texas...........		3		1	2		
	— 1	—14		— 5	— 14		
Ohio.............		3	1	3	6		1
Indiana..........	1	4		1	6		
Illinois..........	1	8		2	7		1
Kentucky........		3	1		1		2
Tennessee.......				1	1		
	— 2	—18	—2	— 7	— 21		— 4
North Dakota...		2			3		
South Dakota....				1			
Michigan.........		5		2	5		
Minnesota.......		2					2
Wisconsin.......		4		2	4		
Iowa............		4		5	4		2
Nebraska........		3		1	1		1
Missouri.........		5		1	3		1
Kansas..........		7		1	7		1
Oklahoma.......		1		1	1	1	
		—33		—14	— 28	—1	— 7
Colorado........		1					
Washington......		1		1	1		1
California.......		2		1	2		
Arizona..........		1			1		
		— 5		— 2	— 4		— 1
Totals..........	15	90	5	43	102	2	18

approval; and the preparation of a form which will be fairly acceptable to all is a difficult matter. We doubt if any one or two men can evolve such, no matter how comprehensive their experience or how broad their appreciation of local and personal inclinations, without the actual coöperation of well informed men representing many kinds of practise, sizes of cities and geographical locations.

The most encouraging return from the canvas was the general agreement in the idea that standard forms are desirable. Only two saw no benefit in such standards; about twenty were only mildly enthusiastic, but a considerable percentage were emphatic in their belief in the desirability of standard forms. A few typical replies to the question "*Would the general use by water works officials of standard forms of any kind be of service?*" are as follows:

It would tend toward standardizing and simplifying the work; would place before each member, whether large or small plant, the best practise in water works operation.

Undoubtedly, as it is by comparison that we learn things.

It would be of much use to see what we are accomplishing compared with other cities.

It would seem as if it would benefit all, unless there is so much detail that small stations are not equipped to furnish the information necessary.

Yes. For when a statement is made of cost, leakage, pump slip, income, consumers per mile, etc., all could be placed on the same basis, and you would know how you compared with other plants.

Yes. A correct form would not only allow of comparisons, but a thorough analysis of the individual plant would be more easily made by using one of these comprehensive systems.

I do not believe results could be obtained by using one standard form, because the conditions in each plant are different. . . . . It is hard to compare a filtering plant with one that does not filter its water. . . . From the average data obtainable, it is quite impossible to compare plants using steam, gas, oil or electricity for the prime mover. However, I believe a uniform report for each class would be very valuable to all water works plants.

We have found it a good reference table from which to answer numerous special inquiries of other water works.

Possibly, but all municipalities must be governed by local conditions.

It makes a good form of office and public record, even if used for no other purpose.

Although, as stated, the most common reason given for not adopting the New England form was ignorance of it, still a few objections to it were stated. The most common were that it is too complex for a small plant; that the city or company is too poor to employ sufficient help to prepare the data, and that private companies do not wish to make such information public. Typical replies are:

Any uniform system so far devised has not been applicable to water works of large and small size; one that would apply to a system of 30,000 to 100,000 consumers is too expensive for one of 1500 to 4000 consumers, requiring an elaborate system of bookkeeping.

This form has not been used because local conditions form such an important factor and vary so.

Because of former lack of system in our water department.

Uncertainty of tenure of office, as about the time they attempt or are ready to use standard forms of reports a political change occurs, and his successor in office follows the same groove.

Have not been in the water works business long enough to form an intelligent opinion. (*A corroboration of the previous one.*)

Lack of time to properly attend to same.

Wisconsin utilities are obliged to use the classification of accounts prescribed by the state railroad commission.

The state of Iowa has adopted a uniform system of municipal accounting and made it mandatory for all cities of 5000 and over. (*Similar answers from Ohio also.*)

Because the matter has not been energetically brought to the attention of water works officials.

As we are not members of the associations you refer to, we do not receive the forms mentioned. The salary of a superintendent of a water works system in towns of 5000 and under is not large enough for him to belong to these associations personally, nor to incur the expense necessary to attend conventions and meetings. The majority of commissioners operating such systems (who are generally politicians) do not see the advantage of having their superintendent belong and attend such conventions. . . . . A letter should be sent to commissioners urging them to have their municipality a member of associations, and the advantage to be gained.

Lack of proper records, inadequate office force, or the ignorance, indolence or lack of interest of the head of the water works.

The work involved. Probably it could be simplified so as to induce its more extended use.

Because its urgent importance and necessity are not apparent, and a great many water works officials, like other humans, always put off those things which do not have to be done.

Because of its cumbersomeness. We have a much better system here that I have designed.

The expense of printing them.

A great many water works plants are run in a more haphazard manner considering the amount of money involved, than any other line of business.

Coming now to the ideas as to the aims of standard forms, we find the following opinions:

Forms should be made thorough, that is, covering all facts relative to plant and operating and maintaining same, and at the same time should not be complicated.

To show costs in minute detail, and in a general way all sources of income.

A good and fair comparison of conditions and expenses.

A very compact report of expenses, receipts, etc., can be made which will show with very little figuring the cost of each line of work in the water works business, and also just what part may be running at a loss.

Municipal deficits; corporate profits; how to give good service at reasonable rates.

To show the comparative economy and efficiency. It should prove the advantage or otherwise of general metering; high-duty pumping engines; what is a fair price for water; what should be charged off for depreciation.

Simplicity and clearness.

Uniformity and accuracy.

To give briefly, for each department, the cost of maintenance, upkeep, gross and net earnings.

Simplicity. To secure greater efficiency.

Comparisons of operating conditions.

Comparisons of operating efficiency.

Several complained that the form herein discussed is too complicated for them to use. Most of these are in charge of small plants, it is true, but the majority of the plants of the country *are* small ones; and these should therefore receive at least equal consideration with the large. Moreover, the large plant is more likely to have available the ability to expand a condensed form along practicable lines, than the small one is to condense a form too complicated for its use. If either extreme must be sought, therefore, it seems to us that it should be simplicity rather than elaborate comprehensiveness. Another argument for this is that it is much easier to persuade an official to adopt a simple form, and later educate him to a more elaborate one, than it is to secure, even by state law, an adequate and reliable use of a complicated form by one who has never before filled out a form of any kind. Too complicated elaborateness is, in our opinion, a handicap of the form proposed by the committee of the American Water Works Association which will absolutely prevent its adoption, at least until officials have been educated by several years of experience with a simpler one.

General experience in corresponding with and examining the reports of water works superintendents has convinced the writer that there are in this country at least five hundred of these which have at hand data sufficient to answer a considerable proportion of the questions contained in the form herein discussed. The difficulty lies in persuading them to do so; in demonstrating to each one the advantage of it, and then in overcoming his disinclination to exert a little effort in performing work which he is not compelled to do.

If the conclusions drawn from this correspondence are correct, two things would seem to be necessary: First, to prepare, for each branch of municipal service, forms which are sufficiently simple and at the same time sufficiently broad to appeal to the majority of officials in charge of the work in question. Second, to see that this form is made known to all such officials in such a way and at such a time as will be most likely to induce them to adopt it.

What is the best plan to adopt in preparing such forms is a question deserving careful consideration. It would seem that for each branch of work the preparation should be in the hands of men experienced in that branch. It would also seem to be desirable that more or less uniform principles be adopted as the foundations for all the forms. It is therefore suggested that a committee, with sub-committees of experts in each of several lines, be appointed; following the idea embodied in our committee on standard specifications, which has worked out so well.

As an appendix, the writer presents a form for street paving which he has had prepared by one experienced in that class of work. This is not offered as a practicable form for present adoption, as it is too comprehensive to meet with probable acceptance by many street departments at the present stage; but rather as indicating the valuable information which might be gathered when officials have been educated to an appreciation of record keeping and cost accounting; and also as an effort to set forth in detail the scope of one of the classes of municipal work which the condensed forms should outline and skeletonize. It may be added that this is essentially the form used by certain of the largest paving companies in this country, and the figures entered therein are carefully calculated and used as a basis for bidding, calculating profits, etc.

There are also added as Appendix No. I letters received by the writer setting forth the ideas of two experts in the line of municipal accounting.

APPENDIX I

COMMUNICATIONS

Extracts from letters from J. E. Treleven, Secretary, writing for Prof. J. R. Commons, Director of the Bureau of Economy and Efficiency of Milwaukee

I fear that it is impossible, within the limits of a letter, to set forth just what the principles are on which our various cost accounting systems are based.

However, I can say that we have adopted, as far as practicable for municipal work, the principles of private cost accounts, that is, we have attempted to set up in each bureau or department all of the elements of cost ordinarily recognized by cost accountants.

As you will readily see, this involves the determination of several factors which have not been ordinarily considered in municipal accounting. For example, increases and decreases of city proprietary interest, the pro rating of monthly salaries to job orders, the establishment of reserves for depreciation, employers' liability, and the like. When I spoke of the necessity of determining the basic principles upon which the systems should be based before designing the systems themselves, I referred particularly to the settlement of questions relative to the inclusion in the schedule of accounts, the items such as those mentioned above, of which cognizance is ordinarily taken in private work, and up to the present time have received little attention in public accounting. We believe that when standard practices regarding the treatment of items of this nature, and also payrolls, charges to job orders, the correct methods of pro rating over-head charges (on which point there is considerable controversy among accountants generally) have been determined upon, each department or activity offers a separate problem in cost accounting.

In working up the cost system for any department the procedure then would be as follows:

First, the unit of work must be determined, that is, a study of the activity must be made to determine what the units of work are. For instance, in the street cleaning department, the unit of cleaning is one or one thousand square yards, etc. There are as many of these units as there are different types of street cleaned.

After the units have been agreed upon the next step is to analyze the work to determine the processes through which it passes. In the oiling of a street, for example, these processes are:

Hauling materials, hand sweeping, hauling and hand spreading oil, spreading oil with horse drawn broom, spreading sand.

If unit costs only are desired, process costs need not be determined, but if an analysis of the records is to be made to show points of excessive cost, etc., process costs must be obtained as well as unit costs.

After the entire activity has been analyzed the cost system is installed. This system follows the standard practices previously determined upon, modified to meet whatever conditions are peculiar to the activity under study. A schedule of accounts is one of the elements of a cost accounting system.

I fear that this letter does not fully meet your requirements, but I trust that it will point out some of the elements that we have determined upon as essential in cost systems for municipalities.

While your plan of securing a system which would be the composite work of a large number of persons interested would undoubtedly meet a heartier reception at the hands of the municipalities than one designed by one person or group of persons, because of the embryonic stage in which municipal cost accounting is found today, and because of the great variation in the ideas of municipal accountants such coöperation as is necessary to perfect this system will probably be somewhat difficult to obtain. It is likely also that considerable time would necessarily elapse before the approval of a considerable number of persons interested in municipal accounting could be obtained, or any specific plans presented.

It would seem as if perhaps the best method of securing coöperation in this matter would be to secure by correspondence or pamphlets an expression from municipal accountants regarding several phases of the work proposed to be undertaken—later when the basic principles on which it is desired to base the work have been sufficiently formulated to permit of intelligent discussion, a meeting of those interested in the work might be arranged at which plans for carrying the work to a logical conclusion could be determined upon. It has been our experience here in Milwaukee that producing departments, such as water, and other public utilities, and constructing departments, such as streets, lend themselves most readily to the adoption of unit and job cost systems.

It would be our suggestion, therefore, that some activity of the public works department be the first department in which the uniform system be installed. We would call attention to the fact, however, that before even one system is completed, the basic principles upon which the entire cost system is to be based must be determined upon.

Mr. A. Prescott Folwell, Secretary,
The American Society of Municipal Improvements.

Dear Sir: The necessity of uniform methods of recording as a preliminary to the establishment of standards of efficiency in municipal service needs no argument among those familiar with the conditions prevailing in municipal service. One of the principal objects of organizations like the Bureau of Municipal Research, is to introduce such methods and to establish such standards. Greater progress has been made on the accounting side than on the development of suitable service records. In the field of accounting, as you are of course aware, much has already been accomplished by various Bureaus of Municipal Research, by the Metz National Fund for

Promoting Municipal Accounting and Reporting and by President Taft's Commission on Economy and Efficiency. It would be most fortunate if some central agency could be established similar to the second above mentioned, for the purpose of standardizing the methods of recording service rendered. It is a matter requiring considerable careful thought, in my opinion, to determine how far the unit cost method can be applied. So far as it can be applied accurately, it is undoubtedly most desirable.

I need not say that as far as we find it possible, we should be glad to coöperate with you and any others in the effort to bring about the desirable end.

Very truly yours,
R. E. Miles,
Director, Cincinnati Bureau of Municipal Research.

Appendix II

INFORMATION TO BE EMBODIED IN COMPREHENSIVE RECORDS OF STREET CONSTRUCTION AND MAINTENANCE DEPARTMENTS.

It is proposed to have a complete record for each class of pavement; but as many of the items would be similarly designated in each class, the forms are abbreviated in the following by giving the complete form for one class only, and indicating by numbers the items which are repeated in the others. Group together pavements of the same kind and age, and give data for each group.

NEW CONSTRUCTION

BRICK PAVEMENTS

Data for the year ending........................19....
1. Number of contracts or jobs totaled or averaged......................
2. Length..........miles. Area..........sq. yds.
3. Grading: Average {estimated / measured} depth..........Material.............
Haul..........miles.
4. Base: Depth..........Material.................Proportions..........
5. Cushion: Depth..........Material....................
6. Brick: Make..........Size........Material (clay, shale, etc.).........
Record of tests...
Number per sq. yd. of pavement.....................................
7. Filler for joints: (Cross out kind not used). {Sand, description.................................
Bitumen, kind..................................
Cement grout, proportions.....................}
Amount per sq. yd................

Prices and Costs

8. Grading, per cu. yd. $........Final disposal, debit or credit $.........
9. Base: Stone, per cu. yd. $...Sand, per cu. yd. $...Cement, per bbl. $...
10. Brick: Cost per thousand at siding or yard $....Haul, per thousand $...

11. Joint Filler: Bitumen, per gallon $....Sand, per cu. yd. $....Cement, per bbl. $..........
12. Labor, per day of......hours $....Bricklayers, per day $....Teams, per day $..........
13. Cost per sq. yd: Labor $....Bricklayers $....Teams $....Material $... Foreman and others $..........Total cost $..........
14. Remarks..

CREOSOTED WOOD BLOCK

(Repeat items 1, 2, 3, 4 and 5.)
Wood Blocks: Kind of wood........Size of blocks......No. per sq. yd.....
Character of preservative........Amount per cu. ft........
Filler for joints: Character..........Amount per sq. yd..................

Prices and Costs

(Repeat items 8, 9, 11, 12, 13 and 14.)
Wood Blocks: Cost per thousand at siding or yard $.............Haul, per thousand $..........

STONE BLOCK

(Repeat items 1, 2, 3, 4 and 5.)
Stone Blocks: Kind of stone........Size of blocks......No. per sq. yd.....
Filler for joints: Character..........Amount per sq. yd.................

Prices and Costs

(Repeat items 8, 9, 11, 12, 13 and 14.)
Stone Blocks: Cost per thousand at siding or yard $..........Haul, per thousand $............

SHEET ASPHALT

(Repeat items 1, 2, 3 and 4.)
Binder or Cushion: Depth........Materials..........Proportions........
Surface: Depth..........Materials............Proportions...............
Haul of binder and surface material................miles.

Prices and Costs

(Repeat items 8, 9 and 14.)
Binder: Stone, per cu. yd. $......Asphalt, per ton $....Oil, per gallon $....
Surface: Sand, per cu. yd. $.....Asphalt, per ton $....Oil, per gallon $....
Powder, per ton $........Fuel, $..........Haul to street $......
15. Labor, per day of......hours $........Foreman, per day $......Skilled labor, per day $............Teams, per day $..........
16. Cost per sq. yd: Common labor $......Skilled labor $......Foreman and others $..........Teams $......Material $......Total cost $..........

BITUMINOUS CONCRETE

(Repeat items 1, 2, 3 and 4.)
Surface: Depth..........Materials..........Proportions..........
Bitumen, kind............Amount per cu. yd..................
Haul............miles
Flush Coat: Materials............Mineral matter per sq. yd.............
Bitumen per sq. yd.............................

Prices and Costs

(Repeat items 8, 9, 14, 15 and 16.)
Surface and Flush Coat: Stone, per cu. yd. $......Sand, per cu. yd. $......
Asphalt, per ton $........Tar, per ton $........
Oil, per gallon $.....Mineral powder, per ton $.....
Fuel, $..........Haul to street $..........

BITUMINOUS MACADAM

(Repeat items 1, 2 and 3.)
Base: Depth..........Size of stone....................................
Bitumen, kind......................Amount per cu yd.............
Top Coat: Depth..............Size of stone............................
Bitumen, kind................Amount per cu. yd............
Flush Coat: Mineral matter, kind.........Amount per sq. yd.............
Bitumen, kind................Amount per sq. yd.............
Distributed by hand or by machine.........................

Prices and Costs

(Repeat items 8, 14, 15 and 16.)
Base: Stone, per cu. yd. $..........Bitumen, per ton $..................
Top Coat and Flush Coat: Stone, per cu. yd $......Bitumen, per ton $....
Oil, per gallon $....................
Mineral powder, per ton $..........Fuel $....
Haul to street $.........................

CEMENT CONCRETE

One or two layer work...

(Repeat items 1, 2 and 3.) If two layer work, repeat 4. If one layer, omit the word "Surface" in the following.

Surface: Depth..........Aggregate, material and size..................
Proportions ....
Method of finishing surface...................................

Prices and Costs

(Repeat items 8, 14, 15 and 16)
Stone, per cu. yd. $......Sand, per cu. yd $........Cement per bbl $.......

MACADAM

(Repeat items 1, 2, 3 and 4.)
Base: Depth..........Material..........Size of stone....................
Top Coat: Depth..........Material..........Size of stone..............
Water or other surface application............................

Prices and Costs

(Repeat items 8, 14, 15 and 16.)
Stone, per cu. yd. $..........Water or other material $..................

ORDINARY MAINTENANCE

For the year ending..........................19....

(Group together pavements of the same kind and age, and give data for each group).

Kind of pavement..................Age............Total area...........
Total amount of material employed in renewing, patching, etc.............
Number of sq. yds. of pavement renewed { not over cuts.................. / over cuts.....................
Maintenance work other than renewing, describe.........................

Costs

Total cost of maintenance since construction, prior to year in question (not including cuts) $..........
Cost of renewals during the year per sq. yd. of surface renewed (not including cuts) $..........
Cost of renewals during the year, averaged over whole surface $...........
Cost per sq. yd. { of renewing pavement over cuts $............ / of other maintenance, descrided above $............

RECORD OF DEFUNCT PAVEMENT

(Including those which are renewed or replaced for any reason.)

Name and limits of street.........................Laid in 19............
Kind of pavement..............Main points of specifications.............
Records of any tests made of materials.................................
Character of street, business or residence...............................
Width between curbs............Width between outer rails of tracks......
Direction of street..............Shaded or not...........................
Character of subsoil, including drainage............Per cent grade........
Traffic, through or local....................
Traffic record: Number and kind of vehicles per day...................
Care of street: Cleaning...
Sprinkling...
Flushing...
Condition of pavement when removed.................................
Percentage of pavement relaid over cuts during life..................

Prices

Contract price or cost of pavement per sq. yd.... Term of guarantee....yrs.
Average annual cost of repairs $............
What area, if any, maintained by street railway or others, and not included in above cost...
Value of old materials or work remaining................................

DISCUSSION

THE SECRETARY: I took water works as the subject of this investigation, because as far as I know the form for waterworks was the only form adopted by societies of general influence and that had been made a study by those interested in it, and so it was about the only one we could inquire into as to previous efforts. You can easily transfer these forms of expression from terms of waterworks to sewer construction or street paving or what not. The same advantages or disadvantages would apply largely to other branches of public work.

As to the general matter of standard forms, I do not know how many think it desirable and how many do not. Most of you who have come here have come to learn something from each other. The only way to do that is by comparing experiences, and the only way you can compare them is by comparing them on a common basis having a common unit of comparison. How many have tried to compare experiences and have found that they were not using the same unit of value, were talking about a different pavement, different unit prices. One man says it costs $1.15 to lay brick pavements; another says $1.50, labor conditions the same. Come to find out, one man included excavation, foundation, surface, and also probably the connections between the corner inlets and the sewer. The other man did not include any of those, except the base and the pavement. The excavation, setting the curb and putting in the basin connections were separate. They were talking at cross purposes, and thought they were comparing results but were not, because they didn't have a common basis of comparison.

I think our talks could be made much more useful if we could adopt some standard of comparison. When a man comes here and says he is paying $1.50 for brick pavement, let it be known what he means; let it be understood what his records include under the head of "cost of brick pavement."

Here is another point. If we appreciate all that, and want to compare records, one man finds $1.50 in his record. He appreciates that this includes setting the curb and the excavation and basin connections. He realizes also that the other man's figures do not include that, but that doesn't help him. He cannot separate his record now, cannot tell what his brick pavement did cost him, and he cannot compare with the other man. If we could agree on some common basis in street cleaning, garbage collection and sewer building and all things of that sort, our work here would be greatly increased in value. When we come to discuss results, we must have units of comparison. That is why I am interested in this matter of standard forms.

Another thing. You are undoubtedly aware that I am not the only man who thinks standard forms desirable. This society started some time ago to get up standards for street pavement, and only two weeks ago I saw a paving advertisement of Brooklyn, New York, which said, "This pavement will be laid according to the specifications of the American Society of Municipal Improvements." I believe the work done by this organization in the getting up of standard forms for street pavement has done more to make it useful and give it a standing in the community than anything it has done in the last five years, and we haven't reached the limit of that yet. Standard specifications will still need fixing up year by year, but the probability is that another year will see us nearly run out of material on this matter of standardization of pavements. I do not see why we should not have committees organized along the same lines on standard forms, and get our standard forms adopted by the cities throughout the country. The National Census Bureau at Washington has seen the necessity of this, and I thought I could work with the Census Bureau last year. The head of the Census Bureau is a man of voluminous statistics, and he started with too big ideas, and he never could get the officials of the smaller cities to adopt his forms. But there was an assistant in the department who had visited the cities and who had reached sensible ideas on the subject, and he and I talked the matter over, and at the last convention I thought he and I would pull together, and that is the reason I asked for a large sum of money, so that if I saw the Census Bureau was going into the thing, and there was a chance for us to walk along like twin brothers, and for the society to share in the glory, I would have sufficient funds to work with. It turned out the other way around; the Census Bureau tagged behind, having had their appropriation cut off, and this man was compelled to leave the bureau and go into some other department of the government. So we have now to work by ourselves, but I believe we can advertise our society by doing good to our brother engineers,—which is the only advertising we want—and get other engineers to be members by such work as this, because it is very important work and is necessary in order to carry to perfection the intercommunication of ideas, which is the purpose of our society.

MR. CHRIST: I believe the Association for Standardizing Paving Specifications had a committee on uniform bidding blanks and bonds, but do not believe they ever reported on a uniform bidding blank. I think that would overcome a great deal of the evil the secretary speaks of.

THE SECRETARY: Undoubtedly that would be so. It would naturally follow.

REPORT OF COMMITTEE ON SEWERAGE AND SANITATION

In reviewing the progress of events in the field of sewerage and sanitation during the past year, it is very evident that representative governing bodies in both the United States and Canada are taking a greater interest. This is particularly noticeable in regard to the districts surrounding the Great Lakes, where an organization known as "The Great Lakes International Pure Water Association" has just had its second session at Cleveland.

POLLUTION OF SURFACE WATERS

There appears to be a general consensus of opinion among those representing state health authorities that the time has come when some definite action must be taken by the federal government. This is necessary, for while one state may have most drastic laws with reference to "river pollution," the adjoining state may have none. As an illustration the Chicago drainage canal may be cited, where, by the simple but barbaric method of turning the sewage from its own water front to a river flowing through a neighboring state, there was caused much litigation and hard feeling. This central control also applies to Canada, where this question has reached the same stage and where the central authority at Ottawa is being asked to supervise surface water pollution. Representatives from the United States and Canada have already had three meetings to work out a line of action in order to obtain the necessary data on which to pass an international policy taking all the states and provinces and centralizing under one association. The following bill was introduced in the Canadian Senate last year and after being discussed was referred to the Committee ot Public Health and there is little doubt that this or a similar bill will become the law in the near future. The bill briefly provides as follows:

> Every person is guilty of an offense against this act and liable on summary conviction to the penalties hereinafter provided, who puts, or causes

or permits to be put, or to fall, flow, or to be carried into any nagivable water, or into any other water any part of which is navigable or flows into any navigable waters:

a. Any solid or liquid sewage matter; or

b. Any other solid matter which, not being sewage is poisonous, noxious, putrid, decomposing, refuse or waste; or

c. Any liquid matter which not being sewage, is poisonous, noxious, putrid, decomposing, refuse, or waste; unless such matter, whether solid or liquid, is disposed of in accordance with regulations or orders made or permits granted under the authority of this Act.

While such a bill is drastic, there is no doubt but that it is necessary. Throughout the United States and Canada practically all the waterways and watercourses in the populated districts are so hopelessly contaminated that they are unfit as sources of water supply unless artificially treated, and these are the principal sources of supply through this country. While it is possible to filter a polluted water, it is better to filter a slightly contaminated water than an altogether contaminated water; providing, of course, you cannot get an unpolluted supply. In this country at present sanitarians rely more upon filtration and treatment of water supplies than upon the treatment of sewage. The Lake Michigan Water Commission adopted a resolution in which they stated that on that lake sources of supply, even twenty to thirty miles from the point of entrance of large quantities of sewage, are not safe places from which to derive water for domestic use. The Water Commission appointed at Toronto to investigate the source of that city's supply as to Lake Ontario, found that polluted water could be obtained sometimes as far out as 14 miles in Lake Ontario. Tests were made of water every half mile out, both at the surface and 75 feet below and islands of polluted water would be found at different points out for the distance mentioned. In one instance a sample was taken about one mile out and was found free of B. coli with a bacterial count of 70 per cc. Twenty feet away another sample showed B. coli and a bacterial count of 13,000 per cc. This is interesting as showing that, under certain conditions of the lake and wind, the sewage polluted water does not form a combination with the colder and cleaner water. In nearly every case the samples near the surface were purer than those taken 75 feet below.

A study of the chemical analysis of the lower Great Lakes shows that the average amount of chlorine in the water is, at Detroit 4.7, Cleveland 10, Buffalo 10 and 6.5 in the middle of Lake Erie, the west end of Lake Ontario 8.5 and the east end 6.8. The analysis for the west end of Lake Ontario shows that the amount of chlorine has increased two and one-half times in thirty years, while the easterly end shows that the amount of chlorine has doubled in twenty years. The increase in the chlorine indicates sewage pollution, which, if not stopped or minimized, will in time render Lake Ontario unsafe for use as a public water supply. On account of the agitation now being carried on and mentioned before, it is probable that most of the cities, on the Great Lakes anyway, will be treating their sewage with the resultant decrease.

THE TREATMENT OF SEWAGE

The object of all present day methods of sewage disposal has been to knowingly or unknowingly take advantage of the oxidation process through the intermediary of living organisms. Those that have failed are those which have not supplied these micro-organisms with a sufficient supply of oxygen to carry out their functions. In connection with sewage treatment there are two distinct factors: (a) The removal of all causes which may effect a nuisance; (b) The removal of all causes which may effect disease.

Most of the standard methods of sewage disposal using screens and sedimentation tanks perform only the functions of clarification to a greater or less extent. By filtering through slag or stone the nuisance is altogether removed and at present in only exceptional cases is the sewage treated to effect the total removal of disease germs. On account of the great cost and the cheaper means of treating the water supply by means of the addition of very small quantities of hypochlorite of lime as low as two parts in one million, it is very seldom that the sewage is treated beyond the filter stage.

This then seems to be the theory of the sanitarians of the present day, namely, to remove from the sewage only the chemically organic attributes which create a nuisance by decomposition. No longer do we find the septic tank being built, for, being wrong in principle, it is doomed as an integral essential to any method of sewage disposal. Instead, we have the sedimentation tank in some cases and a great vogue for two story tanks, of which the Imhoff is at present the most popular.

For years we have known that sunlight is a wonderful bacteriological agent and that the active rays were the ultra-violet rays of the sunlight. Acting on this theory, special lamps have been devised to create the greatest possible quantity of these ultra-violet rays and experiments in sterilizing water have been going on for some time. As a result, Marseilles, France, has installed a 130,000 gallon plant for sterilizing water by this means. The cost of sterilization could not be ascertained, but 99 per cent of the bacteria were destroyed.

PAPERS

This committee has been fortunate in securing several papers on the Imhoff tank, the purification of sewage and the sanitary condition of Dallas. The committee wishes to extend its thanks for these papers to Prof. H. N. Ogden of Cornell University, Mr. C. H. Baumgartner, city engineer of Dubuque, Iowa, and Mr. E. L. Dalton of Dallas, Tex.

ANDREW F. MACALLUM, *Chairman*,
W. J. PARKES,
A. N. TALBOT.

IMHOFF TANKS

By HENRY N. OGDEN, *Professor of Sanitary Engineering, Cornell University*

Although there are many questions about sewage disposal still unanswered and although the reasons for much of the accepted practice are not known, still the advances both in practice and theory during the past twenty-five years have been as persistent as they have been phenomenal. In the middle of the nineteenth century, or fifty years ago, the sewage problem was only just beginning to be felt. Partly because of the rapidly developing manufacturing establishments and partly, as a corollary of the above, because of the concentration of population in towns, the small English rivers received more and more organic refuse until they became grossly polluted and a menace to the health of those living in the vicinity, and this experience has been or is being repeated by all other countries.

It would be the millennium, indeed, so far as streams are concerned, if their quality was a matter of public concern, if their banks were always kept free from rubbish and filth, if crude sewage never found its way into them and if factories, of their own accord, built elaborate plants to treat their wastes so that only pure waters might be added to the streams. But today only the most optimistic can even foresee such a vision and until such a millennium all streams must continue to receive organic wastes from cities, factories and farmlands.

The problems to be solved in connection with such a use of our streams are—How may an engineer gauge the ability of a stream to receive pollution? and How may the amount of organic matter in waste material be reduced or modified so that the results of the treatment shall permit the wastes to be turned into a stream already overloaded?

The first problem is far from settled. The first definite assertion was that a stream would purify, that is, receive without detriment, one-fiftieth of its volume of sewage but would not receive one-twentieth; but this does not regard the condition of the stream into which the sewage is discharged except as the range of values from one-fiftieth to one-twentieth takes it into account. Recently great stress has been laid on the amount of dissolved oxygen found in the stream and one of the recent standard treatises on sewage disposal says that "theoretically, while any dissolved oxygen remains there should not be putrefaction; practically any value below 50 per cent of saturation is likely to be accompanied at times by malodorous conditions." Another treatise says that there is a conflict of opinion in this regard, the range varying with different writers from 20 to 70 per cent of that necessary to saturate the water.

The English sanitarians have attempted to agree upon chemical standards which should draw the line between permissible effluents and those not fit to enter streams. Thus, the Rivers Pollution Commission of 1868 required that no liquid should be discharged into any stream if it contained in suspension more than one part dry organic matter in 100,000 parts of liquid or more than three parts of dry mineral matter. On the other hand, the stipulation under which the sewage from the Passaic Valley is to be discharged into New York harbor provides that the sewage shall pass through various screens and basins of specified sizes but no definite requirement as to composition is made. The absolute foolishness of even trying to establish uniform practice in the United States or even in any one state, so that all sewage and waste water will be brought to the same plane of inoffensiveness is evident when the great difference between the character of the different streams is considered.

For example, the lower Hudson near Poughkeepsie is and always will be a polluted stream, while the upper Delaware is an overgrown mountain brook. He would be a bold man, indeed, who would ask on purely sentimental grounds that the sewage of Poughkeepsie be purified to the same extent as that of Cooperstown, both cities now discharging crude sewage into the above mentioned rivers.

Out of such uncertainty as to requirements comes a clear note from England as a result of a law suit over the pollution of one of their rivers—the Tame. The city of Birmingham alleged that the sewage they were turning into the river was purified quite enough for such a river as had to receive it, while the River Commission claimed that the sewage must be completely purified, no matter what the quality of the river water. The decision of the court was that—"You may not discharge into any stream that which makes it worse. . . . . Nobody may make worse a stream by discharging the water into it that has received its excrementitious matter. What you must not discharge in the stream is water that conveys that which will make it worse."

The principle thus established, namely, that sewage or other waste matters need be purified only to that point where their quality shall be as good or better than that of the stream into which they are discharged, may not be precisely that which should always govern the degree of purification required in the United States, but it does indicate without doubt the growing tendency to design each sewage disposal plant with particular reference to the degree of purification required by the particular stream into which that particular sewage is to be discharged. No longer, then, will expensive sand filter beds be built to convert sewage into drinking water when the stream receiving such water is already foul. Nor, on the other hand, will septic tanks be built for sewage treatment with the idea that by a few hours' stay in a tank all pathogenic germs and all odors can be removed.

With this fundamental fact, namely, that sewage treatment is a most variable requirement depending on local surroundings established, let us consider in a few words only, the part that the Imhoff tank may be expected to play in the series of sewage disposal processes which are available to a present-day sanitary engineer.

In the early days of English experimenting, great attention was given to the suspended solids. Apparently it was felt that if the visible particles could be removed, it was all that could be asked. Chemical precipitation, particularly from 1880 to 1890, seemed to be the most promising method of securing this and chemical salts might have been today the basis of sewage purification except for the trouble which the precipitated solids gave. About one-half of 1 per cent of the volume of sewage treated was precipitated as sludge and the problem of disposing of this was most serious. Today, the cities of Worcester and Providence, where some 20 to 30 cubic yards of sloppy putrescible sludge must be removed inoffensively every day, would doubtless consider the sewage problem solved if this foul-smelling mass could be eliminated.

The Imhoff tank has for its claim on the attention of engineers two points, namely, it will, so it is said, remove from sewage passing through it, at least as much if not more of the solid matters contained as any other analogous method and it will so affect the sedimented solids that they will not smell on standing and will dry out easily, decreasing their volume at least one-half. If the tank will do this last, that is, operate without smell and cut the amount of sludge in two, it is well worth having and the inventor may well be hailed as one of the great benefactors of the human race.

There are two fundamental principles underlying the design and construction of this tank; First, the volume of sewage in which settling is going on is not subjected to any disturbance by rising gas bubbles, and, second, the sludge is allowed to undergo digestion in a deep tank for many weeks. The first seems like a small matter and yet anyone who has watched in a stagnant pool of surface water a string of bubbles rising here and there to the surface, will doubtless also have noticed particles of black spongy-looking material follow the bubbles upward. In a sewage tank where decomposition is going on the phenomenon is most marked and it is not uncommon for bubbles to bring up to the surface of such a tank pieces of sludge as large as a man's hand.

It now seems a little thing to argue that better sedimentation would be obtained if the bubbles could be eliminated and yet a trapped tank bottom for sewage sludge is apparently a real invention of Mr. Imhoff. The trap is made very simply by making the bottom hopper-shaped (which also facilitates the downward motion of the sludge) and by carrying one side past the other so that gases rising from underneath are deflected up along the outside. The beneficial effect of this sort of tank bottom is unmistakable and may be gauged by figures so far as they are available, showing comparisons between this tank and others in the percentage of solids removed from sewage.

Mr. Fuller (1909) says that from 50 to 65 per cent of the total suspended matter in well screened sewage can be removed by sedimentation in basins holding from six to twelve hours average flow. Mr. Fuller also says that in all sewage from 30 to 40 per cent of the suspended matter is so fine that it is not responsible to the laws of subsidence. At Plainfield, N. J., where the tanks are shallow, 54 per cent reduction in suspended solids is obtained and at Reading, Pa., 75 per cent. Somewhat more than these percentages can probably be obtained with a deep circular tank. Thus, at Birmingham, England, where Mr. Watson has used tanks 30 feet deep and 40 feet in diameter, 80 to 90 per cent of the suspended solids can be removed. Probably the exact amount will depend upon the character of the material in the sewage, the presence of chemicals from factories being a factor in the increase of the sludge while a purely domestic sewage is likely to produce much smaller quantities.

With chemical precipitation a greater proportion of the solids can be precipitated. The actual amount of sludge formed is about 50 per cent greater than with plain sedimentation and a large part of this consists of the chemicals introduced to affect the precipitation. Probably a domestic sewage which would lose 50 per cent of its solids by plain sedimentation would increase this amount to 90 per cent if chemicals were added in the proper amount.

The Imhoff tank is said to throw down 95 per cent of the "capable-of-settling" suspended solids and the advocates of the Imhoff tank explain that the term "capable-of-settling" refers to that proportion of suspended matters in the sewage which will settle out in a measuring glass when allowed to stand quiescent for two hours. If Mr. Fuller's estimate of the amount of colloidal matter in sewage not capable of settling is 30 per cent, then the remainder, 70 per cent, is that which remains as precipitable after the use of chemicals; and if the Imhoff tank will throw down 95 per cent of this, it means that, of the total suspended solids, it will remove 67.5 per cent. This should be compared with the 50 to 55 per cent which is obtained from strictly domestic sewage and it is probably correct to say that the increased efficiency of the Imhoff tank due to the separation of the rising gas increases the deposit of solids from 10 to 15 per cent.

The second and more important principle of the Imhoff tank, however, and that on which the growing popularity depends, is its remarkable performance in taking care of the sludge after it has been thrown down from the sewage. Three reasons are assigned for this.

In the first place, below the settling tank proper there is provided a large compartment in which the sludge is allowed to remain for a long period of time, from three to six months, during which time decomposition proceeds and effectively destroys the organic matter so that when finally the sludge is removed it is odorless and much reduced in quantity. This, however, is not new. As far back as 1899, experiments were carried on at the testing plant of the Massachusetts State Board of Health in the hope of carrying out complete disintregation of the suspended solids by prolonged septic action in a separate tank. So in 1908 Dr. Travis built at Hampton, England, a two-story settling tank through which the sewage passed at a high rate in the upper compartment and at a low rate in the lower compartment, where the proportion of solids was much greater. In all these cases, prolonged settling in a tank resulted in a gradual and general disintegration of the organic material and the amount of sludge to be finally cared for was reduced more than one-half from that originally deposited. Even in the bottom of an ordinary septic tank, about one-half of the solids were broken up to such an extent that they did not have to be considered in the matter of final disposal.

But in all these cases disintegration proceeded only with a large emanation of sulphuretted hydrogen and the process, even when the physical benefits were considered, was so offensive as to be entirely impossible. Perhaps no single element has worked more against a greater use of the septic tank than the fact that during the septic process offensive gases are given off. It is to the elimination of these odors that the energies of the inventor of the Imhoff tank were directed and for this purpose he provides a separate tank for disintegration of solids but he carries on that disintegration without producing odors. His second point, therefore, was that there must be through the sludge compartment no moving or renewed fresh sewage. The construction of the tank seems to solve this problem and the reason has been given as follows:

In septic tanks the liquid sewage and the deposited sludge undergo decomposition together, while in the Imhoff tank all supernatant liquid passes through the tank so rapidly that no septic action is obtained although in the sludge underneath a very high degree of septicization may be going on. It is said, therefore, that the organic matter in solution, either true or colloidal, is that part of any decomposition that is responsible for offensive gases and that the deposited solids not subjected to renewed application of fresh sewage do not in their decomposition become offensive. This may explain why the Travis tank smells and the Imhoff tank does not. Other theories have been advanced and perhaps, for the present, one is as good as another, but the general testimony of engineers who have seen Imhoff tanks in operation is that there is at the tanks and in their vicinity no objectionable odor.

The third point which seems to be fundamental in the design is that the deposited solids shall be overlaid with 25 or 30 feet of liquid. Shallow tanks do not seem to be as effective as deep ones and the reason assigned for this is that the gases of decomposition which are produced in the lower strata must, on account of the high pressure, accumulate in greater volume and in their escape produce a greater separation of the sludge particles than in shallow tanks. It is to this action of the gases in the lower layers of the sludge deposits that Mr. Imhoff ascribes the marked porous condition of the sludge which gives it its rapid drying properties after being taken from the tank. The decomposition which goes on at the bottom of the Imhoff tank also gasifies and liquefies a large proportion of the solids originally deposited.

It is not easy from a practical standpoint to separate the effect of the digestion of the organic matter in sludge from the effect of decreased water proportion, since both have the result of decreasing the amount of stored material. Based on experiments of Dr. Spilner and Mr. Blunk, Chemist and Engineer respectively for the Emscher Association, the fresh sludge deposited in the lower compartment contains, on an average, 95 per cent of water. After remaining several weeks or months in the septic chamber, it will contain only 75 per cent of water and about one-third of the original organic matter will have been either gasified or liquefied. Through these two agencies, an original volume of 100 cubic yards of fresh sludge will be reduced, according to their experiments and figures, to a volume of 16 cubic yards—a shrinkage in volume of about 84 per cent. They assert that through septic action only, an original five cubic yards of dry sludge matter will be reduced to 3.92 cubic yards—a reduction of 22 per cent. The largest part, therefore, of the reduced volume is gained by the loss in water, this being pressed out on account of the great depth of tank, or indirectly by the greater pressure of entrained gas.

The reduced volume of sludge coming from the tank is not the only advantage. The quality of this sludge is quite different from that of ordinary sludge found in septic or sedimentation tanks. Instead of being compact, non-porous and in texture much like asphalt or rubber, Imhoff sludge is porous and much like a sponge in texture. In the former case drying proceeds with difficulty and only after prolonged exposure in thin layers to favoring atmospheric conditions. The Imhoff sludge, on the other hand, is so porous that the contained water disappears readily, drying out so that it can be spaded in about five days and is thereby still further reduced in volume so that its volume is about 40 per cent less than when emptied from the tank. In the Essen Valley, this sludge, except for a slight tarry odor, has always been found by American visitors to be free from objectionable odors—a most marked contrast to some of the septic tanks and drying beds which have been built in this country.

Perhaps a final word should be said as to cost. An engineer hesitates to recommend the construction of an underground structure when he knows that it involves a continuous fight against underground water and since sewage disposal plants are generally built on the lowest ground where foundation soil is the poorest and where the ground saturation is most complete, it is inevitable that the cost of tanks 30 feet down will be high. Wisner estimates the Imhoff tank to cost twice that of shallow tanks designed to provide for the same volume of sewage, although the actual volume of the Imhoff tank is somewhat less. The settling compartment of the Imhoff tank is perhaps only one-fourth that of ordinary tanks in volume but the storage compartment for sludge underneath is so great that the total volume of the tank is nearly that of an ordinary settling tank. Apparently the practice of Mr. Imhoff is to make the upper compartment large enough to hold about two hours flow and to make the lower one twice this size. This makes the Imhoff tank large enough to hold about six hours sewage flow, which is about the capacity of the more recently built septic tanks.

The cost of the Imhoff tanks is higher even with smaller capacity because of higher unit prices in both excavation and masonry linings. The question, therefore, resolves itself into this: Is the greater sedimentation, the freedom from odor at the plant and the vastly reduced labor of disposing of the sludge sufficient justification for an increased cost of construction of the tank and for the patent fee which the inventor very properly claims? It has been said that there is no opportunity for equalizing the variable flow in so small a tank and that for best results a large tank (sedimentation) ought to precede the Imhoff tank action. But with every criticism considered, and with full appreciation of the difficulties of the deep tank construction, the boon of an odorless sewage disposal plant is so great and the elimination of the sludge problem so gratefully appreciated, that its rapid installation in this country cannot but follow its European successes.

SEWERAGE AND SANITATION

By E. L. DALTON, *Dallas, Tex.*

These subjects have been so ably presented to the Society at former meetings, and will again be at this meeting, by such eminent authorities—engineers of national and inter-national repute—that the writer will present merely a few "thought subjects" bearing on local conditions.

SANITATION

The subject of sanitation and the best means to produce most effective results has taken such a wide range, causing so great a divergence between theory and practice—a clash between medical and engineering sciences—that competent and able authorities are bending every effort to construct a binder that will cement them into a bond that will be a triumph for science and a barrier to ignorance, indifference and incompetency.

Such a consummation is reasonably assured. It is only a question of time. The more thorough the preparation the less dangerous and more successful the operation. Ultimate success will be hastened by a judicious application of common sense, combined with scientific information, in the physical preparation.

Cleanliness is paramount in effective sanitation. Spasmodic, outward cleanliness is of very doubtful efficacy. Municipalities, unfortunately, are subject to periodic spasms of virtue to gain temporary ends, or to mitigate temporary impending evils. These sporadic and periodic outbursts are very expensive—too frequently an injudicious expenditure of public moneys—and without lasting results. Well devised systematic methods, rigidly adhered to, will produce results justified.

Municipalities should have a systematic cleaning up going on all the while, thereby establishing a preventive of disease. Merely cleaning streets and alleys in an unscientific, political way will not produce good sanitary conditions. Not only must streets and alleys be kept clean—clean all the while—but premises must be kept clean, individuals must be kept as cleanly as possible, vitiated air and surroundings must be removed. A campaign of education of the masses must be constantly waged. How? That is the all perplexing question.

Municipal officers are supposedly selected for their capabilities as teachers and instructors. Let us hope for the millennium—that in time they will in reality be so selected.

We have our laws. But laws do not make men efficient. Good laws are often rendered obnoxious by the method of enforcement. The powers that be, who sit supinely by and issue edicts as follows: "Thus saith the law, you must obey," seldom have the laws enforced.

Public officials are the chosen representatives of the people—the leaders, not the drivers—and the writer often imagines that if said leaders would study conditions intelligently, would cultivate the people assiduously by changing the form of their edicts into the following: "We, your representatives, find such to be the law, we believe such to be the better method of enforcement, we need your help, your full coöperation and aid, without which our best efforts will be negligible, aid us and thereby aid yourselves," a mutuality would exist, a confidence be established that would call forth combined effort to surmount all obstacles; and health, happiness, contentment and prosperity would surely follow.

Systems are essential. Lack of system is waste. But over-systematizing is a bane. Prudence and common sense should here take hold. The trend in all affairs is rapidly toward efficiency. Demand for efficiency begets the necessity for efficiency experts.

COMMISSION FORM OF GOVERNMENT

The commission form of government in vogue in Texas is deservedly praised and commended, but a high state of efficiency has not yet been reached. In changing from the old aldermanic to the new form of government too many of the old ideas have remained. For instance, the commissioners take upon themselves ministerial and administrative duties that could be better performed by the heads of departments.

It is the writer's impression that the real intent and purpose of the commission form of government is that the commissioners' duties shall, in the main, be executive; a board of directors, as it were, to plan, counsel, advise and direct the workings of the subordinates. In other words, employ efficiency experts to manage and superintend the respective departments; the commissioners as a body exercising advisory and supervisory control.

The life and popularity of the so-called commission form of government, and its stability as well, will depend upon how near it will approach to or reach the methods controlling large private institutions.

SEWERAGE

Great strides have been made during recent years in the improvement of sanitary and sewerage conditions in Texas. The writer believes this can be rightfully considered as one of the results of the commission form of government. A board of commissioners has more power, greater latitude in handling finances, issuing bonds, etc., and as an attendant result has called forth more ability and a wider range of intelligent thought and action. This thought and action extends to all branches of the government and all classes of improvements.

In most of the systems the sewage was and is emptied into the streams, thus polluting same and creating a menace to public health. Texas cities and towns have wakened to that danger, and during the past four or five years sixty-seven sewage disposal plants have been built.

In many instances the cities installing these plants have had to pay royalty fees. It is a much mooted and disputed question whether, where, and to whom these royalties should be paid—if they should be paid at all. This society has the subject under consideration and it is to be devoutly hoped that a fair, just and equitable solution will be reached. If the society would appoint a committee to go thoroughly into this subject and, so far as possible, definitely settle the question, it would remove much trouble and confusion when advising cities what is best adapted to their respective purposes.

The engineer, when preparing plans for a city, should be hampered as little as possible with the question of patent rights. He should be free to give his best thought and advice without regard to secondary issues. The writer has been informed by prominent engineers in the East that the Imhoff tank infringes on the Cameron patent; that other tanks infringe on other patents. These issues should be removed as far as possible from intelligent consideration of what or which is best.

The pollution of streams is receiving attention by our lawmakers. At the next session of the Texas legislature, Mr. J. C. McNealus, senator from Dallas, will introduce, and it is to be hoped will succeed in having passed, a comprehensive bill to prohibit and prevent the pollution of the streams of this state. Aided by an effective state law, the cities and towns will be in a far better position to enforce adequate regulations, and more greatly conserve public health.

In planning sewerage systems very few towns have sufficiently considered, if considered at all, the possibility that said towns might become cities, and cities have failed to provide for larger growth. The old systems become inadequate, patch work begins, money is wasted, until finally they are confronted with a problem that, financially, seems impossible of being surmounted.

A competent engineer at first, a comprehensive plan, a look ahead into the future, would have been not only a great saving of money, but in many instances a saving of human life.

The city of Dallas is an example. True, the most optimistic could not have accurately foretold the immense growth of that city in such a short period of time, nor can we now conjecture to what enormous proportions it will grow. It just keeps on growing and growing. The city has voted $550,000 in bonds to build a trunk line and sewage disposal plant, and employed Mr. Fuertes of New York as consulting engineer. I understand he favors the installation of the Imhoff tank at Dallas. The board of commissioners, as I am advised, will a little later on, ask the people to vote a bond issue, the proceeds of which is to be used in rebuilding at least the system in the business district. A large amount of money will have to be expended in Dallas in rebuilding and reconstructing its sewerage system, and it cannot and will not be long delayed.

The city has more than 100,000 population and is rapidly increasing both in population and territory. It has more than doubled its population during the past ten years and it is a safe prediction that it will repeat the performance during the next ten years, if not go further. This rapid growth has precluded keeping pace with it in sanitary appurtenances, but the government is now looking to the future and will build for the future. The sewer pipes were too small at the beginning, and had to be extended as the city grew. As a rule six inch pipes are the maximum size, though there are a few larger in the business district.

To give an idea of what these six inch lines have to carry I will cite two instances, namely: In the "Near Town" district one 6-inch line is serving approximately 5000 people, and another in the residential district approximately 6500 people. Even the congested business district is being cared for in the main by 6-inch lines.

Of course it is realized that this condition cannot be much longer endured, nor do our authorities intend that it shall be, for Dallas is a modern city and all of its appurtenances will rapidly become modernized and be made ample.

I have cited conditions in Dallas merely for the purpose of warning others of what is sure to follow if scientific and intelligent action is disregarded.

The day of efficiency and the efficiency expert is at hand. *Both* are needed, are absolutely essential to make the "City *Beautiful*," the "City Economic," the "City Perfected."

SANITARY PROBLEMS OF THE SMALL CITY

By CLARK G. ANDERSON, *Commissioner of Public Works, Moline, Ill.*

I would amend the generally accepted definition of engineering, formulated by Tredgold, to read as follows, when applied to municipal engineering and especially when applied to the sanitary problems of the small city:

"Engineering is the art of directing the great sources of power in nature to the use and convenience of man"—without offense and cost to the taxpayer.

In a great number of cities consideration of the assigned topic would terminate at this point, for the reason that progress in adopting sanitary measures for the small city may be defeated on the one hand by the engineer or sanitarian who refuses to deviate from idealistic conceptions of what should be accomplished and on the other hand by his superior officer. The latter too often is a politician, blind to necessities and prone to divert public money to the display features rather than to the health and moral features of community life.

Digressing just a moment I wish to state that the rapidly increasing tendency toward commission rule for cities is opening up promising opportunities for municipal and sanitary engineers to broaden their fields of usefulness in their respective communities by seeking and securing the office of city commissioner. By so doing they will have voice in the matter of distributing public money as well as supervision of the actual work. This may sound like rank heresy because professional pride forbids us from dabbling in politics. It would seem, however, that human nature and public opinion is just as potent a "source of power in nature" as are weather and physical elements, and as worthy of our talents, especially when directing it wisely to the "use and convenience of man."

The sanitary problems of the small city are less extensive than but have the same general characteristics as those of the large city and divide themselves into five general groups: (1) Isolation of infectious and contagious diseases, (2) water supply, (3) foods, (4) disposal of wastes, (5) living conditions and environments.

It is impossible for the small city to attain the perfection in solving these problems that is attainable in the large cities, because the available public funds and the possibility of obtaining high grade talent to apply upon these problems are limiting conditions which generally prevent the small city from approaching the ideal.

The first group of problems, the isolation of infectious and contagious diseases, is generally left to the medical fraternity to care for. Every small city of over 5000 inhabitants should have a properly equipped hospital with isolation ward. Lacking these facilities, resort may be had to quarantine of dwellings in cases of mild diseases and the use of isolated tents or old buildings for the more virulent diseases such as small pox, yellow fever, typhoid and tuberculosis.

It is not sufficient to isolate well developed cases, but the municipality should go a step farther by tracing the diseases to their origin, if possible, by the use of standard means of fumigation and sterilization of the persons and articles with which the patient has come in contact during the incipency of the disease, and the fumigation of clothing and destruction of excreta during the progress of the disease.

The second group of problems, water supply, are engineering problems the solution of which must be adapted to each respective locality, depending upon the character of the available public supply. Regardless of the source of supply and regardless of whether the waterworks and distribution system be publicly owned or privately owned, the municipality should exercise jurisdiction over the purity of the water delivered to the consumer. Periodic chemical and bacterial analyses (frequency depending upon the source and uniformity in composition of the water) should be made by the municipality as a check against accidental or periodic contamination.

Given an ample and safe public supply, measures should be taken to induce property owners to discontinue the use of shallow wells and to connect with public water mains wherever possible. In case typhoid or other enteric diseases should break out in the form of a local epidemic, the city should investigate the source of drinking water used by the afflicted persons. The writer has in mind a city of 25,000 inhabitants where during the past year typhoid fever broke out among the workmen of a factory and suspicion attached to the public water supply. Upon investigation it was found that the afflicted persons were all using water from one surface well. Chemical and bacterial analyses developed that this well water was unfit for human consumption. The city immediately locked the well pump and prohibited the use of this water, resulting in effectually stopping the further spread of the disease in the factory. A similar condition existing at a school house was treated in a like manner with like results.

The third group of problems, foodstuffs, involves the inspection of milk, meat, fish, fowl, vegetables, ice cream and other articles of food consumed by the citizens. In perhaps most small cities very little attention is paid to this branch of sanitary activities. Where efforts are made along this line they are generally confined to the simple tests on milk and restrictions upon the sale of putrid meats and undrawn fish and fowl, reliance being placed in the judgment of housewives for the rejection of foods unfit for consumption.

The government inspection of meats and "true to label" legislation has in a large measure allayed public suspicion against foodstuffs that are offered for sale, but this fact is no warrant for inactivity on the part of the city government in these matters.

The fourth group of problems, disposal of wastes, is the largest and causes the engineer and city official more concern and trouble than all the others combined. It includes the disposal of sewage, garbage, ash and rubbish, from factories, mercantile establishments and homes.

The more progressive of the small cities undertake the removal of garbage, ash, and rubbish either directly by city employees or indirectly by contract with persons who make this work their business under city supervision. Each of these methods has merit, depending upon local conditions. Other cities require the property owner or occupant of the premises to dispose of these wastes as best he may.

With the rapidly rising land values and more intense cultivation of the acreage contiguous to the cities, it is becoming increasingly difficult to properly dispose of these wastes. Aside from a slight salvage from paper, rags, rubber and metal, they have no commercial value to offset the cost of collection.

If the city is surrounded by country of rugged topography it is often possible to secure control over suitable ravines or low places which may be used as public dumps and filled with the rubbish and the garbage distributed in furrows and plowed under earth. Sometimes the garbage may be fed to hogs, but farmers hesitate to feed their hogs upon garbage collected by others than themselves for the reasons that in making general collections it is not always possible to deliver the garbage in a fresh condition; moreover, careless housewives are apt to throw broken glass, porcelain, poison and other injurious matter into the garbage can.

The time was when small cities dumped garbage into the nearest stream for those lower down on its course to worry about, but a better public appreciation of the danger of contaminating the milk or water supply by this method of disposal is rapidly causing its extinction.

It is rarely the case that garbage from a small city is sufficient for economical treatment in a reduction works, and a crematory for burning garbage and rubbish is inadvisable because of the odor and smoke nuisance likely to be created.

The waste paper nuisance is one that the citizens should be required by law to care for by compelling them to either bale or burn the paper, if produced in quantity, and to require pedestrians to deposit paper in public receptacles in business or congested districts.

If general collection of garbage is made by the city, then the citizens should be required to drain all liquids into the public sewers before the garbage is placed in the cans, and as an additional precaution, the cans should be provided with a drip through which water may drain into the earth. When we consider that 90 per cent or more of the household garbage is water and that with the liquid removed the drained garbage may amount to ½ ton or more for each 10 inhabitants per year, the economy of this regulation becomes self-evident.

Street sweepings, leaves, grass cuttings and manure is another class of wastes at times more or less troublesome to handle. It would be manifestly unfair to deprive citizens of the privilege of depositing part of this refuse on the streets when they take sufficient pride in the appearance of the thoroughfares to keep the parkings or boulevards in front of their premises neatly mowed and raked. If, however, this refuse is not promptly removed trouble is sure to arise from clogging of gutters, inlets and storm drains. Burning this material on the street is objectionable because of the fire risk, nuisance of smoke and flying ash, and, if the street be paved, liability of damage to the curb and pavement.

Such material can however be made a revenue producer by depositing the same in compost beds. The writer has knowledge of one small city where such compost beds were constructed on vacant park ground last year, the intention being to use the material in future park work. A few years ago this city had a compost bed containing from 300 to 500 tons in one of its parks and refused an offer (made by a large nursery) of $14 per ton f.o.b. cars.

During the cold seasons of the year the garbage and refuse problem may be modified considerably in northern cities by requiring citizens to burn these wastes in heaters and stoves, thus leaving only the ashes to be cared for.

The methods previously discussed are only temporary expedients and ultimately the cities will be forced to adopt some permanent form of disposal. Few if any of the smaller cities can afford the construction and maintenance of high temperature destructors if the burden of cost falls upon the revenues available from general taxation. The reasonable solution of the problem would appear to be that the city bear the initial cost and depreciation of constructing and equipping a destructor (the heat from which could be utilized in connection with a waterworks or lighting plant), and then charge the citizens for the actual cost of collecting and destroying the wastes.

With the "swat the fly," "oil the mosquito" and "kill the microbe" crusade combined with the "city beautiful" propaganda abroad in the land, and promoted largely by the gentler sex, it will become mandatory upon city officials to pay closer heed to this subject in the future than has been done in the past.

The small city is prone to limit its activities in street cleaning to a few pavements in the business section, allowing the residential streets to accumulate dirt and filth until local complaint becomes strong enough to force the cleaning. The writer has found after more or less experimenting in a city of 25,000 inhabitants, that an economical, efficient, and satisfactory system consists in giving all of the paved streets thorough cleanings periodically with rotary brooms and flusher followed by pick up wagons. Then, having the city divided into districts, use "white wings" with push carts to pick up horse droppings and coarse débris daily. Each "white wing" is held responsible for the condition of the streets in the district to which he is assigned and as he generally resides within his district his personal pride is aroused and the watchfulness of his neighbors generally prevents loitering on the job. In the outlying residence sections the districts may be quite large, including tens of thousands of square yards of pavement, and decreasing in size so as to include but a few thousand square yards of pavement in the business section where more effective sweeping is done. In addition to the regularly assigned "white wings," a small reserve squad of from two to four men are used as emergency help whenever any particular district shows need thereof.

The periodic machine sweeping combined with rains have kept the streets throughout the city in very good condition and have given the citizens better satisfaction than did the former haphazard cleaning done under the "local complaint" system. The increase in cost was about 20 per cent but the results attained have been greater than the proportionate increase in cost.

The proper disposal of sewage is another phase of waste disposal that is becoming of greater concern than it has been in the past to the officials of the smaller cities.

Considerable ingenuity may be exercised by the municipal engineer in overcoming difficulties in dealing with sewerage and sewage disposal. Every effort should be put forth by the engineer to obtain scientific knowledge of the natural reducing agencies brought into play in the purification of sewage, not alone at the disposal or clarification plant located on the main outfall but also all along the line in the sewers themselves from the time the sewage is deposited until it reaches the outlet. If no clarification plant exists, matters are generally permitted to drift along until public complaint is made of the menace or nuisance created in the water course or channel used as outlet, and then under the stress of emergency, rule-of-thumb methods and broad generalities are adopted for the design of a disposal plant, with only a gambler's chance of success as to the results attained. The better way would be to acquire as complete knowledge as possible of the composition of the sewage at different junctions in the discharge system covering a considerable period of time and all ordinary seasonal and meteorological variations. Having these data in advance of the emergency, the engineer will be equipped to design intelligently in accordance with actual requirements and with better assurance of success.

Public requirements, and statutory enactments against befouling water courses, are closing in with increasing stringency upon the smaller cities and it behooves those of us engaged in this work to prepare to meet these conditions intelligently.

As an illustration, the writer has in mind an investigation which he has begun recently. The situation, briefly described, is as follows; An old main outlet sewer 7 feet in diameter, about ½ mile long, laid on a level grade, spills into a branch of the Mississippi river below a dam forming the head of an hydro-electric power tail race. About a mile below the sewer outlet, on the bed of the stream and extending across this branch of the river and out into the main channel lies the waterworks intake of an adjoining municipality. The adjoining municipality filters and treats its public water and the intake pipe is intact, but public suspicion is likely to arise at any time on the grounds of contamination due to sewage from the neighboring city flowing over the intake pipe. The truth or fallacy of these claims would have to be established, but during the excitement of a newspaper campaign the public might be misled into the demand for a stereotyped form of clarification plant. This would be a physical impossibility without exorbitant cost for the reason that this sewer lies in a restricted strip of ground in the rear of a row of factories and about 25 feet below the surface of the ground which is completely covered by switch tracks, while the outflow is restricted by the dam and power house. Under such conditions what expedients should be adopted, what is actually going on within this sewer, and what, if any, is the need of treatment of the sewage discharged in the stream? are some of the questions to be answered—not on the basis of hasty impulse but on the basis of established facts.

This outfall sewer received domestic sewage from approximately 30 miles of sanitary sewers and water of an unknown amount from storm drains, the overflow of tempering vats, drinking fountains (largely artesian) and water of condensation from the factories. The junction of these feeders with the main outfall is made at different points but the greatest volume is discharged near the upper end of the outfall sewer.

The writer has been of the opinion, founded wholly upon simple physical evidence, that a considerable purification is going on in this outfall sewer and that possibly the introduction of some oxidizing agency would be all that could reasonably be required. The flat gradient and the fact that during a large portion of the year the outflow is submerged in a measure warrant such a belief. To prove or disprove this theory is the purpose of a series of tests which the writer has undertaken. The first set of bacterial analyses show as follows:

1. Samples of river water taken above the dam for the purpose of comparison and determining dilution.
2. Samples taken in tail race about 200 feet below outflow in the thread of the main sewage stream.
3. Samples taken at outflow of main outfall sewer.
4. Samples taken in main sewer about midway of its length.
5. Samples taken at upper end of main sewer in 4-foot combined sewer at about 50 feet above junction with main 24-inch sanitary sewer.
6. Samples taken in main sanitary sewer about 750 feet above junction with main outfall.

Samples taken October 25 and October 29, when the outflow of the main outfall was submerged to a depth of about two-thirds of its diameter

Sample No.	Date	Colony count per cc.		B. coli			Alkalinity		Averages	
		Agar 37½° C.	Gelatine 20° C.	$\frac{1}{10}$ cc.	$\frac{1}{100}$ cc.	$\frac{1}{1000}$ cc.	Me. O	Phenol	Agar	Alkalinity
1	October 25....									
	October 29....	2,000	2,000	–	–	–	136	0	2,000	136
2	October 25....	8,000	30,000	+	+	+	149	0		
	October 29....	18,000	40,000	+	+	+	142	0	13,000	145
3	October 25....	12,000	30,000	+	+	–	166	0		
	October 29....	50,000	105,000	+	+	+	173	0	31,000	169
4	October 25....	75,000	240,000	+	+	+	166	0		
	October 29....	100,000	230,000	+	+	–	162	0	87,500	164
5	October 25....	200,000	390,000	+	+	+	188	0		
	October 29....	800,000	220,000	+	+	+	194	0	200,000	191
6	October 25....	475,000	650,000	+	+	+	230	0		
	October 29....	220,000	260,000	+	+	+	220	0	347,500	225

These meager data afford no basis upon which to predicate conclusions but it is nevertheless interesting to observe the very large reduction in bacterial content between the upper end of the sewer and the outlet; also the decreasing alkalinity. A comparison of the bacterial content of the unpolluted river water with that of the outflow and that of the tail race 200 feet below the outlet where the stream of sewage is quite clearly defined in the larger stream of the tail race points to quite a rapid and material dilution.

Chemical analyses to determine the amount of, and changes occurring in, the organic matter of the sewage will be made in conjunction with future bacterial analyses, not alone of the liquid sewage but also of the sludge in the bottom of the outfall sewer. Observations will be taken before and after floods, during low and high water in the river, and during seasonal variations in temperature and rainfall.

Should it be found that surface drainage materially interferes with the purifying process taking place in the sewer, it will be possible to divert such drainage into other channels and then it may be feasible to reduce the outflowing sewage to a satisfactory harmless state by the introduction of oxidizing or neutralizing agents; or it may be found unnecessary to treat it at all.

In either case, with the suggested data available, the city will be in a position to deal with the problem intelligently when the emergency arises.

Another situation very similar to the one cited exists within this city in a sparsely settled but rapidly developing residential section containing about 700 acres, which must be cared for in the near future. This section is situated on the head waters of the power pool referred to, and above the older portion of the city, but at such elevation as not to permit gravity connection with present sewers and entailing enormous expense for main connection and pumping station, should the sewage be so discharged. If discharged into the pool, which is about ¼ mile wide with a depth of about 5 feet at low water in the river, the sewage would flow over an emergency intake terminating near the remote side of the pool and also over the main intake extending through the pool into the main channel of the river, both of them located

1¼ mile below the probable sewer outlet and supplying the waterworks with raw water.

The problem here consists in determining whether the dilution of the sewage with the pool water and the subsequent course of the sewage through the pool would satisfy the requirements of safety, or if some form of sewage treatment should be adopted. If treatment is adopted, what would best satisfy the requirements?

The fifth general group of problems, living conditions, is most intimately associated with the daily life of the inhabitants and in the small city is likely to be construed as infringements upon constitutional rights of liberty, except when the fault lies with the other fellow.

Included in this group are plumbing regulations, building regulations, more particularly as applied to ventilation in lodging houses, tenements, stores, factories, etc.; regulating the keeping of fowl, hogs, cattle and horses; requiring property owners or tenants to cut weeds on private property and forbidding them to permit putrescible débris to accumulate in proximity to dwellings.

The problems herein given and the cases cited are not referred to as being extraordinary or unusual but rather for the purpose of accentuating the fact that the small city has problems just as important and just as susceptible to intelligent analysis and treatment as those of the large city.

In the small city the official is generally in closer contact with the people as a whole, and more forcibly compelled to yield to popular opinion and demand, than is the official of the large city. For this reason he is also better able to direct public opinion into intelligent demands if he is well informed. The engineer and sanitarian in the small city has unlimited opportunity for study and research along technical lines if he will but take advantage of them, for generally he has a diverse and broad field to work in while the engineer in the large city is restricted to a narrow specialty.

If the local official acquire complete information as to facts and controlling conditions before the specialized expert be called upon, the small city will be able to meet conditions on a basis of maximum efficiency and economy.

DISCUSSION

Mr. Fisher: I have been much impressed with these papers. One thing I would like to emphasize, and which was brought out clearly by Professor Ogden, that no set rules or system of sewage disposal can be recommended by any society, and I think it would be unwise for us to in any way attempt to recommend a system of sewage disposal to apply generally to the cities of the United States. In my city we at present empty all the sewage of a city of 240,000 into the Genesee River, that has, during the summer season, a flow as low as 200 cubic feet per second. The condition of the lower part of the river has become such that it is absolutely necessary to find some further means of disposal. In 1904 we employed Mr. Emil Kuichling of New York, a former resident of Rochester, and one of the prominent engineers of the country, to make a report on the subject of sewage disposal. He spent some two years on the investigation and report, and we joined with him Mr. Rudolph Hering, and Mr. Benzenberg. They made a joint report to the mayor; after which the investigations were carried on and at last a set of plans were made out and a report sent to Commissioner Porter of the state Board of Health of the state of New York.

These plans were taken by him and referred to four eminent engineers, Mr. Allen Hazen, Mr. Goodnow, chief engineer of the Massachusetts Board of Health, Mr. Snow, chief engineer of the Pennsylvania Board of Health, and Mr. Theodore Horton, chief engineer of the New York State Board of Health. These engineers considered the subject. The commissioner also gave a public hearing in the city at which people having ideas on the subject were allowed to present them, and the subject was very thoroughly discussed, and after some slight modifications in the plans they were approved by Commissioner Porter. Work is now well under way. The plans are for an intercepting sewer that takes in sewage with two and a half times as much volume of storm water, and takes it to Lake Ontario, seven miles distant.

The original plans were to pass it through sedimentation tanks, and the effluent was to be taken out into the lake. Since that time the Imhoff tanks have come into prominence, and it is probable that that system will be used rather than the sedimentation tanks. During the present season Dr. Imhoff was in New York City, and Mr. Kuichling and myself had opportunity to confer with him at length on the subject of these tanks. Dr. Imhoff realized that conditions, especially in the northern portion of the country, were different from what existed where his tank had been in use, and that modifications in the capacity of the tanks for sludge would be required. We are making up the detailed plans at the present time. The sludge compartment will have a capacity of 2 cubic feet per inhabitant to take care of the winter months, estimating that it will be impracticable to draw off any sludge for at least four months of the winter season.

In addition to this, we have employed Prof. Whipple, Professor of Sanitary Engineering in Harvard University, and one of the most accomplished men in that line in the country, perhaps, to study the conditions of the river and the lake in the vicinity of the proposed outlet, and for several miles each way, and his report has just been presented. I received it just before leaving home, but it has not yet been made public; the intention being to have another examination made, similar to what he has made this summer, after the works have been in operation some time. The report also is along the line of advice as to what further should be done in relation to the purification or treatment of the sewage.

Some of our local papers were not satisfied with what we were proposing to do, but the city officials said we had no quarrel with anyone who wanted to do more than we proposed, but what we did propose was absolutely necessary and had to be done, no matter how much further the matter was carried; the only reason we didn't recommend anything further than we had was because of the cost. We expect to spend about two million dollars on this plan, and the sewers connected with it.

Professor Whipple will report also on disinfection of the effluent. I think he will report in favor of that, if he finds after the test he expects to make that it is desirable or necessary. Such investigation as we have had made, extending over a period of eight years, by some of the most eminent engineers in sanitation matters in the country, will be of great value to other municipalities similarly interested, and I will see that the results and such details as are practicable be given to the engineering press and can be obtained also by those specially interested, as soon as the reports are in print. I will say further that the matter was also taken up by the editors of the *Engineering News* and *Municipal Engineering*, and the reports of the engineers referred to were substantially concurred in by those journals. I speak of this because there may be other cities similarly situated where the investigations made would be of value

THE PRESIDENT: We should be grateful to Mr. Fisher for what he has offered to do for us. After that investigation, the reports we shall receive from time to time from him on this work will be a very valuable asset to our increasing fund of knowledge on those matters.

MR. MACALLUM: Mr. Fisher said we should not endorse any special treatment. There are only the three things: purification, taking the organic matter out of the sewage, and bacteriological handling. There is one thing in connection with the different kinds of tanks—the percentage of purification of the different systems. With fine screens the suspended matter removed is 65 per cent, organic matter 60 per cent, bacteria 65 per cent; with septic tanks or sedimentation, they take out the same percentage of suspended matter, 65 per cent, the same of organic matter and 65 per cent of bacteria. That is contrary to the statement of the Cameron patent, which claims to remove much more than it does. Chemical precipitation takes out 85 per cent suspended matter, 50 per cent organic matter, and 85 per cent bacteria.

In Hamilton we have two chemical plants, but on account of the expense of operation they are not built nowadays. Referring to what Mr. Fisher stated as to Rochester, the same treatment has been adopted in Toronto. They use the Dortmund tank, and another two-story tank, I think the Travis. The Dortmund tank is practically the same as the Rochester one, screening out the solid matters and removing everything but the suspended matter. The effluent is run out into the lake in a pipe 4000 feet long with holes in the pipe 50 feet apart, so that it is all diluted before it reaches the intake pipe 4 miles distant. There is a clash at present between the city department and the medical department, the medical department claiming that the effluent should be chlorinated before it gets to the lake.

Mr. Craig. At Omaha we are favorably situated in that we discharge our sewage into the Missouri river. We also take our water supply from the river. Two years ago we had a slight epidemic of typhoid. Investigation was made of our water supply. We had labored under the impression that the water in the Missouri river was the best that could be had, and until that time we were all convinced of it. We had a severe winter, the river was frozen over for a considerable time. As the ice broke up in the spring, typhoid began to appear. An analysis of the water indicated that it ran very high in bacterial content, and we were at a loss to know whence it came. We knew there was no sewage of any importance being discharged into the river for a distance of nearly 100 miles, at Sioux City. We obtained a peculiar result from the examination, and that was that the water taken from our new intake, which is considerably above all sources of contamination, showed higher bacterial content than that from the lower one. Between the two intakes we have a sewer that discharges from a population of about 20,000, and yet the water at the lower intake was the better of the two. So far we have been unable to determine why. It has been so impressed upon our minds that a thorough investigation is necessary, that we are now undertaking this. We are making preliminary investigations through the Department of Health at Washington. Dr. McClellan and one or two other doctors have been examining the water above, below and between the intakes. We are giving it a preliminary treatment of sedimentation, coagulation and sterilization. We are contemplating putting in a filtration plant, and this will probably be done in the near future, for even large streams are susceptible of contamination.

The Secretary: One of the papers stated that the septic tank was practically going out of use, which I presume means that new ones are not being constructed as much as in the past. I wondered if that was the fact in this part of the country. Can any of the members here in the Southwest give us reliable information as to whether they are discontinuing their construction in this part of the country?

Mr. Hawley: I do not know of a tank of the Imhoff type in Texas. We are all using septic tanks, and using them with success. I did not quite undertand Professor Ogden's remarks about this. I think we have a dozen or fifteen tanks here in Texas, operating with varying degrees of success. Our water supplies differ; we have artesian water, and in the Pan Handle we have "gyp" water.

In one of the plants there, which is built like the others and which is large enough, we are having trouble. I am trying to see if some chemicals have gotten into the sewage, preventing septic action. At Dublin, with a small population, we didn't get septic action, and the sewage seemed to be the same when it went out as when it went in. I found that a big laundry, that used sulphate of soda in the water and which used a large amount of bleaching powder, was discharging into the line, and on disconnecting that laundry I got perfect septic action. The water used in the Pan Handle has about 3000 parts per million of gypsum, and I am inclined to think that is what is the matter with that tank.

Mr. Anderson: If there are any members present who have constructed Emscher tanks, I wish to know if the owners of the patent covering the septic tanks have in any way molested those cities.

Mr. Hawley: I do not think there is an Emscher tank in Texas. There will be, however, because I am thoroughly convinced it is the best form of tank, and in some of the projects we now have in hand we are going to use that type of tank, whether the city has to pay a royalty or not.

Mr. Briggs. In Erie we have perfected plans for the Imhoff tank in a battery of six. Three members of the state Board of Health have approved the plan, but haven't given us permission to go ahead with the construction until we have constructed and operated an experimental tank for a year, and we have not done that yet. The great question is whether the sewage of our city will work in that tank; and to learn that, of course, it is necessary for every city to experiment with a small tank to see whether anything is to be found in the water, as Mr. Hawley found, that interferes with perfect septic action in the bottom of the tank.

Mr. Crook: We have a septic tank that gave perfect action for about two years. We have, I believe, the first municipal abattoir in the United States, and the water from that was run into the tank and it destroyed the usefulness of the tank. If other abattoirs are built with the expectation of running the "stick water" and grease into the tank, I would advise you to give it up.

Mr. Macallum: Any kind of trade waste should be specially treated. We have had trouble with iron plants, where the treatment with acids spoil the action of the tank. Such waste water should be treated by itself before it goes into the sewer. Cameron of Exeter never claimed the things claimed for his tank in this country. The claims made in this country have never been carried out. I have never seen analyses of effluent going in and coming out that showed anywhere near what is claimed. The only difference between the sedimentation tank and the septic tank is that one you clean out and the other you do not.

THE CITY ENGINEER AND HEALTH BOARD

By JAMES NISBET HAZLEHURST, *Consulting Engineer*

With progressive cities as with prosperous industrial plants, there comes a time when the methods and machinery once entirely effective are no longer adequate.

The modes of yesterday cease to suffice and it is in order to "take stock" today, to plan for tomorrow.

Atlanta, like other wide-awake cities, has come to a realization of these necessities, and through its Chamber of Commerce is to undertake what it terms a "Civic Revival;" analyzing its present needs, with intent of adopting a comprehensive city plan to be suggested by landscape architects and engineers of known ability, after a thorough survey of the municipality and its environments.

Some of Atlanta's outgrown and ancient machinery, overloaded and groaning mightily, with popular agitation daily becoming more acute, clearly indicates "lost motion" somewhere, and a painful lack of constructive ability along "blue print" principles.

But apologies are not in order. Such conditions are not peculiar to Atlanta! They are indications of vitality and a demand for room to grow! More breathing space required, as it were!

Unfriendly critics should remember that the only two finished cities are the dead ones—Pompeii and Herculaneum!

To get back: a realization of these conditions has resulted in a recent call by Atlanta's commercial organization, and the following assignments to the local engineers, members of its Chamber of Commerce: Plumbing, heating and ventilating; streets and vehicular traffic; waterworks—construction and operation; street railway traffic; electrical affairs and fire protection from the engineer's standpoint; viaducts and bridges—construction and maintenance; building from a structural standpoint; terminals and interurban steam traffic; sewers and public hygiene.

The last subject was accepted by the writer, which fact is in part accountable for the selection and presentation of this allied topic, "The City Engineer and Health Board."

From the shadowy days of legend, tradition and history, when the priest and patriarch exercised control both over spiritual and corporal things, healing the sick and casting out devils, down to the period of the barber and leech, who in turn let their mantles fall upon our latter day surgeons and doctors of medicine, by heredity, assumption and common consent, those of this profession have come to exercise plenary powers over our persons and properties in matters of public hygiene.

Our present day civilization has encouraged and permitted the doctor of medicine to dominate health boards and their executive offices everywhere; and with this condition, Atlanta, as with other cities, offers no exception.

In this "taking stock," it was noted that under the health board, a chief of the sanitary department's duties included street sweeping, cleaning, scavenging of dead animals, and responsibility for the removal and incinerating of refuse and garbage; the collection and disposal of excremental matter from privies and vaults; the care and flushing of sewers; the control of drainage; and attached to the department is a fumigating and plumbing inspector, with other assistants.

Needless to say that this department of the board of health demands and receives a high authority and a most generous appropriation.

From the time when pestilence and plague were considered visitations of God, to the dawn of the day when Dr. Southwold Smith, in the first quarter of the nineteenth century, conceived of some relation between filth and disease, notwithstanding the revolution caused by the theory and demonstrations of the brilliant Pasteur, precedent and practice continues to cling far too closely to false standards of sanitation and preventive control of communicable disease.

Considering some of the activities of the usual city sanitary departments, as for instance, street sweeping and cleaning; the collection and disposal of garbage; the flushing of sewers and the regulation of plumbing and ventilation, each and every one popularly supposed to be of vital importance in the combat with disease, and properly referable to and under the direction of the doctor of medicine, through public health measures. In the city of Atlanta, for the fiscal year, the sanitary department, occupied largely with these matters, was allotted an apportionment from city funds of $267,644.

Let us consider briefly to what extent this sum is serviceable in the prevention of strictly infectious diseases, and defined in the Atlanta health regulations as scarlet fever, yellow fever, typhus fever, cholera, diphtheria, small-pox, and leprosy, with such minor diseases as might be stated as mumps, whooping-cough, chicken-pox, etc.

STREET SWEEPING AND CLEANING

The work done in this division of the conventional health department is effective principally, in the collecting and removal of the surface dirt and mitigating unsightly conditions; and few qualified sanitarians would admit that it more than scratches the surface as far as preventable disease through infection is concerned.

It is now known, that disease germs only multiply in the bodies of persons and animals, usually dying early when exposed to light and air; therefore, the idea that such street cleaning or sweeping as is done in the regular order of things can have any impression upon infectious diseases, such as named, is untenable, since nothing short of isolation, disinfection and sterilization is known to be effective in the matter of the chief communicable diseases. That desiccated animal excrement and other organic street-dust are fully eliminated by the usual sweeping methods if entertained at all, is certainly a popular fallacy; the fact being, that in the employment of the old fashioned revolving broom so generally used for street sweeping, even where preliminary sprinkling is required, dust germs are widely disseminated along the line of operation, being carried by the wind throughout the neighborhood.

Considering how far dust germs may be responsible for disease, it is conforting to know that negative results of recent English investigation as to aërial dissemination of small-pox seems to eliminate that method of contagion.

However, for the two diseases of the respiratory organs, pneumonia and tuberculosis, producing more deaths than any other group of diseases to which flesh is heir, their inciting cause is bacterial infection, certainly transmissible through the air we breathe.

Fortunately, according to many of our straightest thinkers and most qualified observers, most species of pathological bacteria decrease rapidly under the effect of light and other open-air conditions; and the belief is generally, that these germs floating as dried street-dust exert far less possibility for harm than is usually attributable to this method of distribution; and that such diseases are generally contracted through direct contact and comparatively close circuits between individuals.

Referring especially to this matter, in a most comprehensive article, George A. Soper, Ph.D., concludes that dust is directly or indirectly the greatest enemy to man; not so much from the microbes it contains, as because *it is dust;* predisposing the delicate structures of the throat, nose and lungs to invasion by microbes or respiratory diseases; but pulmonary diseases generally, together with such other afflictions as typhoid, cholera and yellow fever, are certainly not in the slightest influenced by street cleaning as it is done in Atlanta or elsewhere in this country.

SCAVENGING

The removal of dead animals within city limits, although performed under contract in the city of Atlanta, is properly a sanitary necessity and precaution, while the disposition of human excrement, as "night soil," in unsewered portions of a city are also admittedly a matter affecting the public health, and as such, should be given inspection by and under the regulation and control of the executive health officer. However, perhaps strictly from a preventive standpoint, a requirement for and the regular enforcement of out-house screening, rather than the removal of excrement, should especially come under the province of the health authorities.

COLLECTION AND DESTRUCTION OF GARBAGE

Popular misconception and prejudice in combination with "practical politics" too frequently dictates and perpetuates a mistaken policy in the matters of the collection and disposal of garbage. Generally speaking, some effort is made to classify and separate garbage into combustible materials and kitchen wastes; and with the latter, in the popular mind, sour and malodorous cans are forerunners of some "pestilence which stalks by night."

As has been lately said in a paper before the Congress of Technology, by Edwin O. Jordan, professor of bacteriology of the University of Chicago:

> As a result of premature generalization, the public has warmly espoused a number of wrong conceptions of disease, and of ways of preventing disease.

And referring in this connection to the garbage matter, he says:

> Sanitarians do not admit that even grossly improper methods of garbage disposal can have much to do with the spread of disease in a sewered city.

Continuing, he avers that, so firmly embodied in the public belief is the connection of piles of decaying garbage with outbreaks of infectious disease, that to the average citizen garbage disposal and such matters:

> Bulk large as the chief, if not the only activities of a municipal health department.

Professor Jordan asserts that:

> It is now well known to bacteriologists that disease germs do not "breed" in garbage heaps, but that on the contrary, if added from outside, they speedily die off; the offensive odors of decomposition may be unpleasant and undesirable; there is no evidence that they produce disease or dispose to disease.

While admitting that the house-fly may breed in garbage piles, particularly those where stable manure is present, and fully realizing that under certain conditions this noxious insect may become the bearer of disease germs to our food, Professor Jordan concludes:

> But when the worst is said it must be admitted that the known danger to health from garbage piles and "dumps" is relatively insignificant compared with the danger from other well known, but less popularly feared sources. Disease does not originate in garbage piles, however offensive they may be; the house-fly, how-

ever disgusting and annoying its habits, suffers from no disease transmissible to man, and does not convey disease unless it has access to material in which disease germs are present.

DRAINAGE

The same conclusions are tenable when we consider the indictment against the mosquito as the only known transmittal agency of malaria and yellow fever. It cannot convey these maladies unless it has access to material in the shape of an individual suffering at the time from these diseases. Miasma, or infectious particles, or germs, floating in the air, and emanating from swamps and fen (according to our medical authorities of a very recent past), no longer frighten with their ghostly fog wreaths rising from nearby swamps; but the breeding place of this complaisant and deadly host, and at all times pestiferous insect, is in the low, swampy ground and stagnant pools; hence, to be controlled by a proper drainage system.

A failure to recognize these now well established facts, and instead suspicion of infection from clothing, bedding, cargoes, bilge water, stone ballast, lumber, and even ice, with misdirected effort towards the disinfection and fumigation of suspected persons and things, have cost millions upon millions of money through needless interruption to commerce and traffic, and is responsible for the sickness and death of thousands of individuals during the last century.

In an article by the writer, presented and read before this Society at its thirteenth annual convention, 1906, entitled "Yellow Fever and Sanitation," the etiology of this disease was presented, which, together with correlated facts regarding epidemics of the past, the deduction seemed warranted that, even in a city of the tropics the introduction of modern municipal utilities, especially those of paving and drainage, would effectively safeguard a community from epidemic outbreaks.

In correspondence at the time with Dr. J. H. White of the Marine Hospital Service, who had just successfully stamped out the last fever epidemic in New Orleans, his opinion, which is certainly entitled to consideration, was that where municipal utilities had been provided, that incidentally, and perhaps entirely accidentally, the mosquito was at the same time eliminated, and with it the possibility of contagion. The public utilities referred to were:

Thoroughly controlled water supply, sewerage, drainage and pavements, and these four, not one, but all of them, were essential to the end attained.

Primarily, fundamentally and as a construction detail, the engineer, rather than the health officer, should clearly regulate and control here.

SEWERS AND DISPOSAL WORKS

As is generally known and recognized, when mankind is organized into communities and gathered into villages, towns and cities, the prompt removal of human excreta is necessary, not only for individual comfort, but to preserve and perpetuate life itself.

These poisonous waste products can be handled most conveniently, effectively, economically and inoffensively, by water carriage, either directly or through the medium of underground pipes and conduits, constituting a "sewer system."

The elimination of these wastes, polluting open waterways and drains, and the planning, the laying out and construction of public works therefor have become distinctively the province of the sanitary or municipal engineer. Although by common consent, usually after completion, the operation of these public works devolve upon the sanitary department under its executive health officer.

Since the process of removal is largely mechanical, carried out by physical means, the continued successful operation requires no supervision of one especially versed in medical science, public opinion to the contrary, notwithstanding.

So too, treatment works, created for the purpose of disposing of the domestic and body wastes after sewer delivery, in an offensive and innocuous manner, have only an incidental relation to preventive diseases as far as one's own community is concerned.

It is a very different matter, however, and of far-reaching and vital importance to the health condition of our down stream neighbors that this treatment of our polluted waters should be fully effective; and that the eradication and sterilization of the intestinal bacteria, the causative effect of dysentery, diarrhea, cholera infantum, typhoid and the dread Asiatic cholera, with other water borne or "filth diseases" should be thorough and complete. Here should the bacteriologist have his inning, and the Golden Rule be observed!

As is generally known, flushing with water is useful to prevent and remove deposits in sewer lines when either the volume of sewage, the slope of the pipe, or both, are insufficient. The modern apparatus for this purpose is the "flush tank," or receptacle with automatic flushing device, located in "dead ends" or terminals of sewer lines.

The once universal method of "hand flushing," consisting of filling a connecting cistern with water and by hand raising a flap-valve, permitting the necessary flushing discharge, is now practically obsolete, on account of the time and expense involved; but Atlanta is one of the few cities still depending entirely upon this antiquated means of intermittent flushing and sewer cleaning.

The local board of health has this work also in hand; the last budget showing an available appropriation of $8500 for flushing pay-roll, excluding the value of water used, furnished free by the city water department. At 4 per cent capitalization, this expense would provide a fund of $212,500; sufficient for the installation of perhaps as many as 4000 automatic flush-tanks; far more than there exists any present necessity for. Here at least is *one* condition where, had the engineer instead of the health officer controlled, a different condition would certainly have prevailed; admitting, however, the engineer's responsibility in the first place. Nevertheless, such lack of understanding and continued waste of the public funds seems inexcusable now in any department or official.

PLUMBING AND VENTILATION

These two subjects are usually grouped together, and the enforcement of corrective laws are placed, as a rule, under the Health Board.

Considering the question of plumbing, there exists a fallacy, quite as popular and prevalent as the conception that the garbage can be a menace to the public health *per se*, and a fear, possibly more pronounced, at thought of "sewer gas," through leaky plumbing and fixtures.

To circumvent this danger (?), "water traps," which a child could blow through with a straw, and cumbersome and stringent "rules and regulations" are required and promulgated by legislative bodies, and often fanatically insisted upon by sanitary inspectors and health officers.

In a report to the National Association of Master Plumbers, a year or so since, upon "The Sanitary Significance of Bacteria in the Air of Drains and Sewers," Prof. C-E. A. Winslow, of the Massachusetts Institute of Technology, and a bacteriologist and authority on sanitary matters of international note, says in part:

> The idea of the connection between sewer gas and disease dates back to the days when the cause of the infectious maladies were still unknown. Mysterious miasmatic influences were naturally enough supposed to accompany foul odors of decomposing organic matter. When it was proved that the contagious and infectious diseases are due to the presence of microscopic plant and animal parasites, the case against sewer gas seemed less convincing. On the whole, however, the air of drains and sewers seemed to be of high bacterial purity and all observers who have studied normal conditions in actual sewers concluded that the danger of bacterial infection from sewer air was remote. These results, with the absence of any reliable evidence from the study of epidemics in favor of the transmission of germs by sewer air, have led sanitarians in Germany and the United States to agree with practical unanimity that the danger of such transmission may be disregarded.

Although in England some authorities still maintain that,

> Under some conditions the carriage of disease bacteria by sewer air is a practical possibility. . . . . I believe, however, that my results, in the light of all previous evidence, warrant the conclusion that the chance of direct bacterial infection through the air of drains and sewers is so slight as to be practically negligible.

It is very apparent from the evidence that simpler requirements and less expensive organizations should prevail, and further, that the city engineer, or building inspector, could act with equal or greater efficiency, if the work were divorced from an overburdened health department and transferred.

VENTILATION

The art, or process, of replacing foul air by that which is pure, in any inclosed place, as a house, a church, a mine, etc., is also considered a health measure, but here, too, there is evidently considerable popular misconception and prejudice.

In buildings the "foul air" is generally considered to be the by-product of the oxygen of the air by respiration through the lungs, in the shape of carbonic acid gas; by which, the air of our crowded rooms becomes more or less vitiated.

Even here, according to Dr. Soper:

> It is reassuring to know that air which has passed through the lungs possesses practically no poisonous properties of chemical composition in spite of the teachings to the opposite effect, which is a favorite theme of text-books. The unpleasant odors are objectionable, chiefly, because they are unpleasant. . . . . The air of an overcrowded and badly ventilated room is slightly lacking in oxygen, but the deficiency is generally not great; and under ordinary circumstances, is readily compensated for by an imperceptible acceleration in the rate of breathing. . . . . Air which has passed through the lungs is loaded with vapor and with carbon dioxide; but in view of the harmless nature of the latter gas, its presence need not, under ordinary circumstances, be considered of great importance.

Along the same line, T. H. Crowder, M.D., superintendent of sanitation of the Pullman Company, from his investigation of sleeping car ventilation, says in part:

> It seems to be established beyond reasonable doubt that discomfort is not due to any changes in the chemical composition of the air, but to physical changes only; and that to maintain a normal heat interchange between the body and the air is to avoid the development of those symptoms which are commonly attributable to poor ventilation. A certain amount of fresh air must be supplied, of course, but the most vital element of the ventilation problems becomes that of regulating the temperature of the air. The question of how to ventilate a railway car is therefore, chiefly a question of how to regulate its heat.

Nevertheless, most investigators admit that the "free air of heaven," or the air out of doors, possesses certain beneficial qualities, which cannot be explained scientifically, nor be produced artificially.

Whether the "close," "stuffy" condition, or the "headachy" feeling, which we have all at times experienced during overcrowded conditions, comes from the need of a more uniform heating system, or is purely psychological; most will agree that regulation and suppression of such matters are necessary; but, perhaps, the chief concern of the medical authorities, where overcrowding is likely to exist—as at churches, places of amusement, or public gatherings, would be toward detection, isolation and quarantine, of individual cases of infectious and contagious diseases, leaving the architect and the engineer to arrange space and supervise the facilities for heating.

THE COMMUNITY BATTLE AGAINST DISEASE

Early in October, at the Fourth National Conservation Congress, Prof. Irving Fisher, of Yale University, boldly declaimed that out of some 1,500,000 deaths, annually, in the United States, at least 630,000 are preventable; and it is against this lamentable and appalling waste of human life that public health work has by common consent directed its batteries.

In its departmental activities, a fair division of the public funds is annually made in the municipal budget; but too often these monies are placed in the hands of inexpert commissioners or boards, who by firing wildly, or scattering their shots, fail to make much breach in the enemy's ranks.

As has been shown, the Atlanta board of health, through its sanitary department, is expending more than a quarter of a million dollars per annum, for street sweeping and cleaning; scavenging; the collection and destruction of garbage; for plumbing inspection and the care of sewers; all, while highly important functions are, after all, largely matters of municipal housecleaning, rather than essential to the public health.

It is true of Atlanta, as has been said recently, under a general indictment by a noted hygienist:

> At present in some cities, the department of health is burdened with the task of caring for the city waste, and its success or failure, as a conservator of the public health, is too often measured by the frequency with which coal ashes are scattered in alleys, or the length of time that decayed vegetable matter remains in tin cans in hot weather.

"MUNICIPAL CLEANSING"

This is the British term for such municipal activities, and municipal sanitation, popularly taken to mean one and the same, is very different in final analysis.

As has been pointed out by others, it is no doubt true, that whatever promotes municipal cleanliness, tends to promote personal cleanliness; itself an important factor in the prevention of contagion; but, perhaps only incidentally, can the prevention of nuisances generally, and the cleansing of streets, alleys and backyards have especial value in the elimination of disease; and further:

> There is little more reason why health officers should undertake these duties than that they should work for free transfers; cheaper commutation tickets; lower prices for coal; less shoddy in clothing or more rubber in rubbers; all good things in their way, and tending toward comfort and health.

If an ounce of prevention is worth a pound of cure, there are many who believe that:

> The chief work of health boards should be directed against the spread of communicable diseases; and that such work starts, continues, and in an ideal state, would end with stopping infection *before it begins;* or in preventing any of the infected discharge of the sick, or of carriers, from gaining access to the systems of non-infected individuals.

DIVISION OF RESPONSIBILITY

Considering, in a general way, the proper relations of those charged with the care of the public health and municipal cleansing, with no especial desire to "Render unto Caesar the things that are Caesar's" but to the end that an effective and economical administration of the community affairs should prevail, a division of authority between the engineering and health departments, is clearly the tendency of the times.

As evidence of this belief, many facts might be cited. In response to a recent inquiry Mr. John W. Hill, Mem.Am.Soc.C.E., and a member of the Ohio state board of health, writes in part as follows:

> I find that the bulk of the work, of this board at least, is of an engineering nature, although the examinations for infectious dis-

eases, especially typhoid, diphtheria, tuberculosis and also the examination of dogs' heads for rabies, is of course altogether of a medical nature, while examinations of water supplies and our own tests of sewage effluent are of an engineering nature.

In many of our most progressive states, the names of engineers appear prominently as members of state or municipal health boards, or as engineering advisers, or chiefs of division under such boards. And it may be noteworthy that there is at least one engineer member on the health boards of the state of Massachusetts, Connecticut, New Jersey, North Carolina and Ohio, while other states, namely, Vermont, Massachusetts, New York, Pennsylvania, North Carolina, Ohio, Michigan, Minnesota, Kansas, Mississippi, Washington and California, have each one or more engineers on their board of health staffs.

Among the cities whose executive health officers are engineers are Montclair, Orange, Elizabeth and Princeton, New Jersey; Philadelphia, Pennsylvania, while the commissioner of health for the great city of New York is a sanitary chemist.

Many of these commonwealths make liberal appropriations for the installation and operation of sewerage and water experimental testing plants; these are generally conducted by members of the engineering fraternity, doing great work towards a better understanding of sanitary problems. Moreover, there is an already large and growing class of professional men, essentially civil engineers, specializing as hygienists and now known as "sanitary engineers," whose advice is sought and opinions taken on most of the important questions of the day relating to the public health, and especially suggestive of this change in public sentiment is the recent selection of one of these, Dr. Rudolph Hering (doctor of engineering and consulting engineer), of New York City, as president of the American Public Health Association, an office heretofore invariably held by a doctor of medicine.

In what has been said, there is no intent or desire, by direct implication or inference, to discredit or belittle the services of the medical men of our public health boards and sanitary departments; whose members are, broadly speaking, men of education, intelligence and patriotism; ranking well with other splendid examples of sterling worth existing in civilized communities; but to emphasize the fact that, in the efficient and up-to-date health department, the medical officer, the sanitary engineer, the chemist and the bacteriologist, all have their place, either acting permanently, or being used in special or consulting capacity.

QUALIFICATIONS OF THE ENGINEER

The stock, or stereotyped duties, of the city engineer, are too well understood to bear repeating; but it is an extension of his efforts in the direction indicated and the desire to secure a proper focus to municipal effort which prompt these suggestions.

In order to measure up to these new and expanding opportunities and higher responsibilities, especial training is most desirable and is becoming a condition precedent to preferable employment.

This scientific preparation can hardly be self-acquired, or come from the correspondence school, but should be included in the curricula of our educational institutions, tending to undergraduate degrees of civil engineering, with opportunity for specialization. Such courses are now given by The Massachusetts Institute of Technology, The University of Pennsylvania, University of Michigan, Harvard University, The University of Pittsburgh, Tulane University. And along this general line, but to less extent, by most of the great universities of the country in their departments of technology.

THE NEED FOR SPECIALIZED INSTRUCTION

In the same way that the engineering schools are recognizing the need of instruction in sanitary science for their graduates having in mind public sanitary service, so the medical departments of some of our first-rate colleges are offering post-graduate courses in which engineering subjects are emphasized. In Canada, three of the leading universities have made provision for a special course, by which graduates in medicine may secure diplomas in public health (D.P.H.), with special training along the same lines for architects and engineers wishing to include this subject in their final examination for the degree of doctor of philosophy (Ph.D.).

Last year the University of Michigan established two new courses in public health work, where the science of both medicine and mathematics was included, leading to degrees of Master of science in public health (M.S. in Public Health) and doctor public health (D.P.H.). In both courses, however, a requirement is that the candidates shall have previously received the doctor of medicine (M.D.) degree.

CONCLUSION

While these advances have been prodigious and far-reaching, each marking the way to higher potentiality in sanitation and hygiene, the need of something beyond is beginning to be more than a vague conception.

Epitomizing from a recent expression by Geo. C. Whipple, Harvard University, published in the *Journal of the Association for the Promotion of Engineering Education:*

> Besides the sanitary engineer and the specialist in sanitation, the world today needs—and the need is very great—a kind of man just beginning to make his appearance—the sanitary executive, or, as he is more often called, the health officer. There are already many so called health officers serving on boards of health. Some of these men are great leaders, well worthy of the honorable positions they hold, but the rank and file of them are ill fitted for their important task. Our public-health machinery was installed when the hygienic wisdom of the town was wrapped up in the family doctor and when the physician was the logical custodian of the public health. With the growth of the science of bacteriology and preventive medicine and the application of engineering all this is changed. The ability to diagnose a case of smallpox and keep a record of deaths is no longer a sufficient qualification for the health officer of even a village, while the growth of our cities is continually demanding that the man in charge of the public health of so many people shall be an expert in his line.
>
> Medical training alone does not fit men for this service. The problem of curing disease is quite different from the problem of preventing disease. The former deals with human beings as *individuals;* the latter considers them as *units of a mass.*

Professor Whipple continuing and explaining what elements are needed to make up the well rounded and ideal public health official goes on to point out that the prevention of disease involves mathematics; since vital statistics are constantly to be compiled and used. It involves engineering; since the engineer must pass upon, and control new sources of water supply, extensions of old sources, systems of sewerage, sewage disposal and the disposal of city wastes; which last would include street cleaning and garbage removal. The prevention of disease certainly requires chemistry and bacteriology for public protection against the adulteration of foods and the determination of infectious diseases and the preparation of antitoxins therefor. Professor Whipple also conceives that the health officer should have some knowledge of law in order to discern and eradicate evils, although perhaps the duties of the health officer should not be entirely repressive and punitive. In his educational capacity, however, and in his ability properly to instruct the people in the arts of hygiene and the principles of right living, is perhaps one of the most important of his duties.

Thus it would seem that the day of specialists in public health matters has come along with the day of specialization in all the arts and sciences.

In answer to this logical and insistent demand, Harvard University is now offering through its Graduate School of Applied Science, instruction to men holding diplomas from medical colleges, and as well, to those who have taken the degree of Civil Engineering from institutions of recognized standing.

Here the two professions merge and weld, and the intent is to erect upon these two splendid foundations a single noble edifice consecrated to the conservation of human lives.

DISCUSSION

Mr. Parks: The writer compares the method of flushing sewers in Atlanta with the present system of flush tanks using a siphon. He says spending $8500 for flushing, the water costs nothing; and that money, if capitalized on a basis of 4 per cent, would provide a fund large enough to purchase 4000 automatic tanks, and therefore concludes that they are wasting money, and that the automatic tank would be cheaper. But that water must cost something, and they would use with the automatic tanks about $36,500 worth a year. If you add to that $8500 interest, you would then have a cost of $45,000 a year in round numbers, as compared with the $8,500 now spent. I do not argue against the use of the siphon tank, but I use this to show the danger of arriving at conclusions without being sure of our premises.

Mr. Hawley: But the assumption of even 500 tanks for that size of city is far too great, and since the tanks are already built for use by hand power, all that would be necessary would be to put the siphon arrangement in.

A METHOD OF SUPPORTING SEWERS IN DEEP FILLS

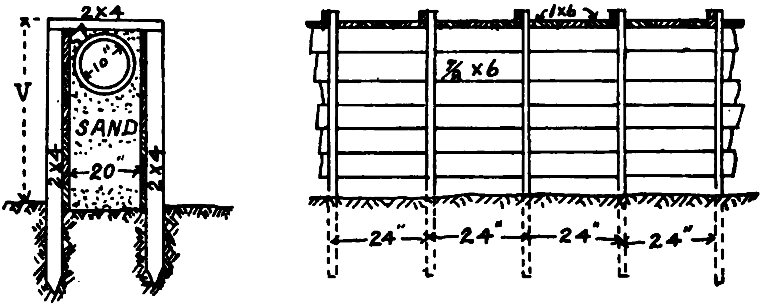
By C. A. BAUMGARTNER, *City Engineer of Dubuque, Ia.*

Engineers are called upon sometimes to provide sewers in streets and alleys which require considerable filling to bring them to grade, and this occasionally necessitates building them above the existing surface and demands a more or less permanent support depending on the nature of the surface and the available fall of the sewer. As very little information on this phase of sewer design is to be met with in engineering literature, and conditions generally vary in each individual case, the resulting structures necessarily exhibit interesting features.

It was necessary for the writer to design a sewer of this kind under the following conditions. The district to be served is located just outside of the city limits, is an old lake bed, and the streets and alleys will require fills up to ten feet in height to bring them to their established grades. This district is located beyond the divide which defines the limits of the shed now served by sanitary sewers, and any extension of these sewers, even at light grades, would rapidly approach the street surfaces; as the grades of the streets, due to their location relative to the divide, fall the other way.

With this restricted fall, any settlement of the completed sewer would materially affect its efficiency. A pier method of support, it was thought, would result in too much settlement. The ideal support would distribute the load over a large area; and with this in mind and the fact it would not be expensive, it was decided to lay the sewer on a laterally confined sand bed.

Only side walls and top were provided, built of tongue and grooved stuff nailed to two by four studdings, driven in the ground and forming pairs, four feet on centers. A sand-tight junction between side walls and surface was secured by sinking the walls four inches below the surface and banking up the sides with earth. To prevent spreading, the studdings were allowed to project four inches above the top of the side walls and spiked to a third two by four cross piece, thus forming pairs.



V varies from 12 in. to 36 in. Sides of box made watertight by use of tongue and groove boards, ⅞ x 6 in., nailed to 2 x 4 posts by three 8-penny nails at each bearing.

Into the box thus formed moistened sand was shoveled to slightly above the grade of the invert, the balance of the sewer being laid in the usual way.

Some little settlement occurred at manholes, but not any could be detected in the sewer proper.

CEMENT PIPE FOR SANITARY SEWERS

By T. C. HUGHES, *City Engineer of Tulsa, Okla.*

For several years, 1907 to 1912, I have been asked to consider the use of cement pipe in sanitary sewer work. After thorough investigation of the manufacture by hand of such pipe, and tests for absorption, I came to the conclusion that it would not be satisfactory for sanitary sewer work.

The very best hand-made cement pipe would absorb from two quarts to a gallon of water per each joint of 2½ feet of pipe 8 to 10 inches in diameter. I regarded it therefore as a dangerous material and one likely to be a harbinger of disease, rather than a *sanitary* sewer material. However, as these objections did not apply to storm sewer work, I opened our specifications five years ago to cement pipe for storm sewer work, inaugurating at the same time a system of inspection of the work at the plant and prescribing its construction as well as the mixture of the materials.

After much experimenting and consideration of the commercial side of the problem, a mixture of three parts graded sand and one part Portland cement was finally decided upon as meeting all conditions in a satisfactory manner. Approximately 150,000 feet of storm sewer pipe of this class have been installed in Tulsa, Oklahoma and have given us very satisfactory results.

One excellent feature of this pipe, which has been demonstrated in our city, is that with age the pipe tends to become waterproof; and when three years old will scarcely absorb any water at all.

This sample which I now show you is a hand-made pipe and was laid about three years ago in a ditch to drain an abandoned pond, and was a piece of condemned pipe, as no use was anticipated for it after the pond was drained. This piece of pipe would, when put in the ground, absorb at least a gallon of water to the joint of pipe, but I do not think it would now absorb as much as a half a glass of water to the joint of pipe.

Prior to November, 1911, a great fight was made in Kansas City, Mo., to open the specifications for cement pipe for sanitary sewers and the clay pipe interests combed the country for information to condemn the cement pipe products. They asked me for my ideas and experience along this line. In my letter to them of November 24, 1911, I explain that I had never used any cement pipe in sanitary sewers, and therefore had no experience along that line, but that it was giving us good service in storm sewer work. And further "that the use of cement pipe for sanitary sewer work was a matter that engineers were becoming divided on, so far as I could inform myself, some holding that cement pipe *could* be made satisfactory for this purpose, while others thought not" (at which time I was wholly considering hand-made pipes). Further quoting "It strikes me that cement pipe could be probably made available for this use, but the principal difficulty lies in the fact that the manufacturers of cement pipe are liable to take too many chances, and the pipe is liable to be made by small and irresponsible contractors located all over the country, without any reputation to be maintained, who have slight knowledge of the work they are doing, and no knowledge at all of the chemistry of the subject, and still less of the physical properties of the cement." Under such circumstances, the chances are not very good to get a first class job of cement pipe such as would give satisfaction in a sanitary sewer; and an engineer could not afford to open his specifications to the use of cement pipe under these conditions.

But, gentlemen, the cement pipe industry is rapidly undergoing a change; the work is now done by machinery, by which the entire pipe is now mechanically tamped with a high speed tamper striking 400 blows per minute of 90 pounds each on every inch of material in the mold. The material can be handled wetter than by hand; the pipe are uniform in density and texture and are immediately transferred from the molds to the curing room, where they are kept thoroughly saturated with water from 6 to 8 days. The pipe are then conveyed to the yard, where they remain for thirty days before shipment. In ten days these pipe are practically water proof and in a few months almost wholly so. In addition to this fact, the inner surface is mechanically troweled and glazed and is waterproof from the start; and all water for crystallization needed after the pipe are in the ground is taken from the outside, inward,—absorbed from the surrounding ground. Such pipe, well made, of well mixed materials, should meet the approval of the engineering fraternity.

When a vitrified pipe is specified, certain tests only are required; —that when broken, it shall show thorough vitrification—this being apparent to the eye of the inspector; that when struck by a hammer, a clear bell-like ring shall be emitted—being apparent to the ear of the inspector; that blisters, etc. shall not break the glaze—all simple tests made on the ground by the ordinary inspector, as it is practically impossible to investigate the various clays and the internal burning under the glazed surface.

Cement pipe is under a different condition; such tests as are made for defects by the inspector on the ground will develop cracks or broken bells. The mixture of the materials on which the true value of the pipe depends, namely cement, sand and stone, must be taken care of by factory inspection.

There is no doubt in my mind that cement pipe for sanitary sewer use is here to stay; that it will steadily win supporters; that it will save the people money; that he who stands out against it will eventually be required to revise his specifications to admit cement pipe. But it must have the confidence of engineers in and to its manufacture.

It is not to be questioned that the more cement there is used in the mixture, the stronger will be the pipe. However, in the construction of pipe, as in all other matters of engineering, the commercial aspect must be kept in view, and the best engineering is to secure the correct result for the least money.

In general, my view of the matter would be that the manufacturers of this pipe should submit to this body a complete set of their specifications for all classes of pipe, and that this body of municipal engineers should pass on, modify and adopt specifications for the construction of such pipe which in their judgment will meet all the requirements; and also to further suggest such means as they think wise to secure its manufacture in exact accordance therewith. These specifications should cover the proportion of materials used for various sized pipe, the mixing of the materials, the kind of cement and the character and grading of the sand, gravel, chats, etc., entering into its composition.

In this way, by working with the manufacturer, harmonious results will be obtained and the confidence of the engineering fraternity forthcoming.

Our city has recently approved the use of this pipe exclusively in both storm and sanitary sewers. A factory has been established in our city and we have no fear that the product will fall below the standard set, or that the result will be other than satisfactory. The pay roll of this factory runs approximately $2000 per month, most of which is left in the city instead of being sent to maintain foreign communities.

The exhibits here displayed illustrating the construction of this pipe should satisfy the mind of any engineer as to the permanency and perfection of the work done in this line, and enable him to reach an unbiased conclusion.

DISCUSSION

Mr. Meriwether: This paper states that machine made pipe could be made denser and would absorb less moisture than hand made. I have had experience with both, and I differ from that statement. I think if concrete is made dry, or comparatively so, the machine tamped will be denser than hand tamped; but if the concrete is wet, I believe the hand made will be denser than the machine made. At Little Rock Mr. Rankin read a paper entitled "Tests on Materials for Sewer Inverts." He showed absorption and abrasion tests on various materials. In those tests the hand made wet mixed concrete pipe absorbed 5.1 per cent moisture; the machine made comparatively dry mixed pipe absorbed over 20 per cent. Some vitrified pipes absorb more moisture than hand made wet mixed concrete pipe. I believe the great thing in this question of effect of sanitary sewage on concrete is to get it dense. The denser the material the better it will resist such acids as you would probably get in sewage or gases. I do not think there should be a recommendation as to whether hand made or machine made is the better, but to make tests on absorption, have certain requirements it must come up to, and let a man make it any way he wants to. Havana is instaling a sewer system, the largest contract ever awarded for sewers in the world, and they are using a concrete sewer pipe, hand made or made by machine, for both sanitary and storm water purposes.

As to the action of sanitary sewage on concrete, the sewage flowing through sewers is fresh sewage and not septic. When the gases are developed and let loose is when the concrete is attacked. That action takes place in the sewage disposal plant, where the sludge and solid matter all goes in, and the putrefaction and septic action takes place. The majority of the disposal plants are made of hand made concrete, and I know of the failure of only one disposal plant. When you get larger than 42 inches, you cannot use vitrified pipes for sewers, because they do not make them bigger, and many cities do not use them that large. There is more cement in the mortar per running foot of 36-inch brick sewers than there is in 36-inch reinforced concrete pipe. The cement in a concrete pipe is denser than the mortar between the bricks of a brick sewer. I know of very few brick sewers that have been attacked and collapsed from the sewage eating up the mortar in the joints, but if it will eat up the cement in the pipe it would undoubtedly eat up the mortar in the joints of brick sewers.

Concrete pipe has many advantages over brick. A 48-inch concrete pipe will give you the same flow as a 54-inch brick sewer. Another thing, the pipe is smoother, and you can lay it on a flatter grade, and not clean it so often. At every brick there is some obstruction and friction, but these obstructions are not present in concrete pipe. If machine made pipe comparatively dry is used, I think the pipe should be kept damp and immersed in water. Some pipe was made in Florida out of comparatively dry mix. It was take out of the mold and kept moist for two weeks. It was not to be used for sanitary sewers, but was made to go around piling in salt water to protect it from the teredo. After this had been on the piles for three months it disintegrated badly. A commission was appointed, with Mr. James H. Fuertes of New York, chairman, and he said that the pipe was not given water enough in the curing, and suggested that the pipe be taken out of the mold and placed in the bay for two weeks before it was used. Pipe made in this manner has been in service for six years and has not disintegrated.

Mr. Rankin: The chief danger is that the cement pipe is too easy to make. Almost anyone can buy an outfit and turn out pipe that looks nice, but the question as to whether it is serviceable or not is another matter. We have used considerable concrete pipe and had good satisfaction. I did read a short paper on experiments I made on the abrasion of materials, which I repeated the following year with some results that showed that good mixed concrete stood a very good test, as compared with brick, better than ordinary brick, and nearly as good as an ordinary paving brick. On the strength of that I have not been recommending since then lining the interior of sewers with paving brick. At the same time I made another experiment, making a number of briquetts and putting them in sewers to find out what effect the acid had on the cement. I made four sets of those briquettes, one set was put in the water in the laboratory as in an ordinary cement test, and the other three in three sewers throughout the city, one where the concentrated sewage from domestic uses was heavy, another in the factory districts where there was a large amount of trade waste, and the third in another factory district where most of the sewage came from the tanneries. I had the chemist determine the character of the sewage, whether alkali or acid, and I think two were slightly alkali and the other slightly acid. This chemical test was made both before and after the placing of the briquettes. They were left there for six months, and strangely enough, when broken, the three sets in the sewers broke at a slightly higher rate than the set left in the water, which seemed to show that the effect of sewage on cement was not as bad as had been supposed.

MR. MACALLUM: After Mr. Rankin read that paper at Little Rock three years ago, I had our brick sewers examined, and I found that one or two layers of brick had gone out of the bottom of the inverts. Most of us have received literature on clay and tile pipe, and I have been curious to find out whether there existed a place where there were acids of such a nature as to eliminate the concrete in pipes. I have not found it in the east or north; it must be down here. In a number of sections of concrete pipe described in the engineering journals they have had their inverts laid with vitrified pipe. They did that in Toronto, but the reason was that the brickmakers had such an influence that they insisted upon it. I have never yet seen a case where it was necessary to line a large sewer with brick, and in sewers I have built, as large as 6½ feet in diameter, we have made them altogether of concrete. The ordinary tile pipe that I have dug up, laid 14 feet down, have invariably been split, but the concrete pipe have not been split.

I made some concrete pipe in the winter time, which may be of interest. We made it in zero weather, reinforced, in 4-foot sections and used salamanders inside of the building to dry it out. It dried unevenly, so that when you rolled the pipe along it would disintegrate. Some broke into sections in the sewer on the two haunches and the center of the crown and the invert, making four sections, but the pipe is there yet, because it settled in place. We then put in some coils in the pipes, and used burlap over the top to keep the steam in and we got better pipes. But I should not make it in the winter time; you take too many chances, and there are too many possibilities of error, and only in cases where you are compelled to build the pipe, as where you are torn up in a busy section and must get the pipes in, would I do it.

The Secretary: Mr. Macallum said he never found a place where the acid has eaten out the cement pipe. We are indebted to Mr. Fort for the only instances I know of, and those were cases in the city of Brooklyn. The city of Brooklyn was one of the first in the country to lay cement pipe, and for twenty-five years perhaps laid nothing but cement pipe for their sanitary sewers. The practice was discontinued as a monopoly some ten or twelve years ago. The instances he referred to were those in which the acid came from some sort of a chemical institution, one instance being below a brewery, where the acid was supposed to come from washing out the old beer bottles returned for refilling, and in that case it had eaten out 100 feet or so of the cement sewer. Another was where the acid from some manufactory had gotten into the sewer and had eaten it. That, of course, was not legitimate sewage.

Mr. Curless: I have had a good deal of experience with cement pipe, both in making and investigating. I have investigated nearly every large city in the United States, and find that concrete pipe, hand made out of natural cement or imported English cement, was in use more generally than clay pipe about seventy-five years ago. The first pipe was brought to this country from England, known as Scotch pipe. It was imported and cost a great deal, and they broke a lot of it. Many cities could not afford to put it in, and therefore they made hand tamped concrete pipes for their sanitary sewers. Nearly all the older cities of the United States today, cities over forty years old, have in their sanitary systems concrete pipes, hand made, in good serviceable condition. Many times it is forgotten. Perhaps some of you do not know you have it in your own cities. I have gone over the ground thoroughly, and hunted for this pipe in the old records, and have taken photographs of it, have had it dug up in many instances and had it examined, and found its condition. It is in good shape and the acids have not destroyed it. In Detroit I found some. I went to the city engineer's office and he told me he had been there for twelve or fourteen years, and was not using concrete pipe. We looked up the old records and found that this pipe had been put in there twenty-seven years before. It was 4000 feet long, but had been entirely forgotten. The men making connections to it would work into it as a matter of course, but as far as the city records were concerned it was forgotten. It was in good serviceable condition, and is that way now. Concrete pipe was made and laid in eastern cities, and in some cities in the middle west.

Later the right kind of clay was discovered, and machinery was brought over from Scotland and England, and they started to manufacture clay pipe. They could make it cheaper in a short time than they could make concrete pipe by hand, and it took precedence. Twenty-five years ago we paid $5.50 and $7.00 a barrel for cement, and it was expensive, and it was not as good cement as that we now get for $1.50. Now we can make a good uniform concrete pipe cheaper than they can make clay pipe, because we are getting uniform cement and have better appliances for manufacturing it. If you take a well tamped pipe as made today under the right specifications and inspect it, you get a more uniform, stronger pipe than with clay. It has been the experience of cities that they are saving 25 per cent on their systems by using concrete pipes, specifying concrete pipe on equal terms with the clay.

We had in operation two plants where the cement was steam cured. One was not successful and was taken out. The other was successful and we are putting in a third one like the second. In the latter we are running steam through a trough of water—

that keeps the cement wet. We put the pipe in a room thoroughly enclosed, and it is in a sweat all the time it is in that room. I do not believe in taking a pipe immediately out of the mold and placing it in the steam room, because the cement has not had time to get its initial set. Therefore, in our plant where we have to use steam on account of the cold weather, as we operate all the year around, we have them place the pipe on the floor and leave it twenty-four hours, and then put it in the steam room, for then you get the initial set of the cement, and by putting it in the steam room after the twenty-four hours you get the stone setting process and help it along. If you put the pipe immediately in the steam you would immediately start the stone setting process before you would get the initial set, and would get your wagon before your horse. We are having good success with the method I have mentioned. The pipe is absolutely uniform, and I believe is stronger than any clay pipe of any diameter.

Mr. Meriwether: I do not quite agree about the steaming of pipe. In Saskatoon, Saskatchewan, pipe was made with the thermometer as low as 30° below zero, and immediately the form was filled, the steam jacket was put around the pipe in the same method Mr. Macallum has described, and the pipe was steamed for three hours, the forms removed and the pipe steamed three days until it was thoroughly cured. Then it was laid in a trench with 40 feet of back fill, and has given satisfaction. Mr. Rankin made some tests on steamed pipes. They were making some with the steam process and others cold. Mr. Rankin made some briquettes and cured some in the regular laboratory method, and the other briquette he put in the molds to be steamed as soon as the briquettes were made. Perhaps he will tell about it.

Mr. Rankin: I remember the circumstance very well, and as near as I can recollect it was a pretty severe test. We put one set of briquettes inside of the pipe that was being steamed. It was in the winter. The laboratory briquettes were put on the roof, exposed to the weather, the idea being they would there get the same conditions as pipe left on a street. I think we made a twenty-eight day test, and we had all sorts of weather, snow and rain and warm weather, so that they froze and thawed several times. Just what the results were I cannot tell, but there was very little difference between the briquettes steamed and those not. I shall be glad to send to the secretary for publication this set of tests, as well as the other one mentioned.

TESTS MADE BY E. S. RANKIN

Test to determine the effect of steaming on the strength of Portland Cement. Samples made February 7, 1911.

Edison Cement

	24 hour neat	7 day neat	7 day 1-3	28 day 1-3
Steamed...............	299	500	66	142
Unsteamed............	84	665	129	191

Vulcanite Cement

Steamed...............	384	669	95	253
Unsteamed............	163	647	169	275

The unsteamed briquettes were treated in the same manner as in a regular laboratory test.

The steamed samples were put in the steam bath in the molds with iron plates on top and bottom immediately on being made and left for one and one-half hours. The molds were then removed and the free briquettes again steamed for one-half an hour, the object being to treat them as nearly as possible like the pipe.

The seven and twenty-eight day samples were then exposed directly to the weather and during the 28 days the temperature varied from 8 to 58, being alternately above and below the freezing point fourteen times. Rain fell on four days and snow on two days, so that the test was exceptionally severe.

Effect of sewage on cement

Four sets of briquettes were made, one of which was kept in water and the others placed in three different sewers designated as follows for six months:

A. Pure water.

B. Intercepting sewer, taking sewage from about one third of the city, residence and factory.

C. Tenth ward ditch sewer, factories and tanneries;

D. N. J. R. R. avenue sewer, factories.

Alkalinity in terms of CaCo	Neat	1-2 Sand
A. Neutral	819	409
B. 0017 per cent beginning of test; neutral end of test	816	412
C. 0031 per cent beginning of test; 0025 per cent end of test	936	414
D. 0013 per cent beginning of test; * 0016 per cent end of test	734	443

* Acid in terms of Sulphuric Acid.

Mr. Curless: Mr. Meriwether makes a very much thicker pipe, because he makes a larger diameter, and therefore he could steam his pipe immediately more successfully than if it had a thinner shell. The pipe I was speaking of was of a smaller size, and I figured the best result was in not steaming them until the initial set had taken place. The shell is an inch thick, while with Mr. Meriwether's it is 3 inches or 4 inches thick, and there would be less action from the direct steam on it, and it would contain more moisture than the thin shell.

The President: What is the difference in weight between your pipe and the clay?

Mr. Curless: Our pipe will weigh a little more than the clay. Our small pipe is $\frac{7}{8}$-inch and the clay pipe has a thinner shell. Our larger pipe will run about the same.

Mr. Meriwether: There seems to be a wrong impression about steaming. The pipe is not steamed to dry it out. The wet mixed pipe that has been steamed has been steamed with very low pressure, wet steam. As a matter of fact, the atmosphere surrounding the pipe is saturated with moisture and depositing moisture, like a thick fog or mist, and it does not dry out; but the high temperature accelerates the curing. After one hour's steaming the pipe would be thoroughly set and wringing wet.

Mr. Myers: What is the approximate saving in cost of material of cement pipe 6 to 15 inches in diameter against the cost of the same sizes of vitrified pipe? We have found it economy to put in concrete pipe less than 12 inches in diameter.

Mr. Curless: If you will write to Houston, Texas, and ask them the difference in their bids received last Monday, they will give you this information.

Mr. Whitley: Listening to this discussion it has occurred to me that one of the important factors has been left out of the question of cement pipe, especially for sanitary sewers, and especially where the flow would be light and the gradient small. That is the thorough inspection and classifying of sand. The sand has been the cause of many concrete failures, so that the people who are manufacturing this pipe would have to be careful in having tests made of the cement, and take great precaution as to the kind of sand they are using.

Mr. Curless: With us the sand and gravel are tested, and the aggregates are carefully graded. Before it is accepted the sand is tested in a laboratory test, and is tested and graded every day by the man in charge of the work.

Mr. Meriwether: It is just as important to test the sand that goes into the concrete pipe as it is to test the cement. In the experience we have had it has been more important. Some concrete was manufactured in Canada last year in which the cement tested absolutely perfect, and the pipe would not set up at all. The sand was analyzed and found to contain a percentage of vegetable matter, which could not be detected in the sand without analysis.

Mr. Parmley: The question of whether concrete pipe is good or bad depends on some fundamentals about which there is some division of opinion among engineers. One is whether it shall be dry concrete or wet or "slush" concrete. The dry concrete seems to have come into use with the rise of the building block industry, where a tamped building block is made in an iron mold and removed immediately. About the same time, or possibly earlier, concrete pipes were manufactured in California for irrigation purposes where some so-called drying processes were used. No great attempt was made to produce impervious pipe, the main thing being to get a suitable pipe for irrigation water in preference to open canals. But if you will run back fifteen years to tests which have been made on concretes of various kinds, especially in beams, you will recall that a sloppy concrete was looked upon with disfavor. That opinion was persisted in in the Department of the United States Engineers, and until comparatively recently their specifications required what many of our engineers would say was too dry a mixture. I have seen some of their heavy foundation work where I think more water should have been used.

There are two extremes in regard to that phase of the matter; one is too dry a concrete, and the other is too wet a concrete. I recall tests made fifteen or twenty years ago, and invariably the concrete beams which showed the highest amount of resistance were those which had, not a sloppy mixture, but a mixture you could tamp. Any more water was then believed a detriment. I do not believe the physical laws of concrete have changed in fifteen years, and what was true then is true now. On the other hand, the question of the amount of water used is controlled largely by circumstances. If you have building work where it is impossible to get the thorough tamping that you can get in the laboratory, as usually occurs in the foundations of buildings and the building of thin concrete walls, you can get more compact concrete by the slush method, where the principal part of the settlement is done by gravity. Only a few years ago one of my friends, a prominent contractor now, made an innovation in railroad practice by building railroad abutments with wet concrete. Since that time the prevailing sentiment has swung to wet concrete. Concrete pipe is built both ways, and what we are interested in is to get the best results. If you have conditions which make it practicable and economical to secure a heavily rammed concrete with a percentage of moisture at or nearly at the quaking point of the concrete, you will get denser concrete than by using more water. I have reduced the percentage of absorption in that way to 2 per cent, whereas by the slush method I find that it is very difficult to bring it below 4 per cent.

As to the question of the acids and their effect upon concrete pipe. Some few years ago I made tests in some outlet sewers. There happened to be a large brick sewer within a little distance from The American Steel and Wire Company's mill, where they discharge a large amount from the pickling baths. There were some nails used in the sewer, and when they had been in place about a year the heavy spiking was completely corroded away, a twenty penny spike was cut off at the line. It was an old brick sewer in use twenty-five or thirty years, but there was no visible effect of the chemical action on the mortar used. If concrete is corroded by the effect of these acids, the mortar would have been corroded, because they are the same material. I know of one metallurgical establishment that is using muriatic acid, and they use it up to 10 per cent, and are now using concrete baths for their processes.

In the manufacture of concrete pipe the thing to be looked after is the result, and if one manufacturer gets good results by one method, and another gets equally good results by another method, they should both be placed on the same basis. Dense concrete can be made by either process, and some methods of manufacture are more economically carried out by one process, and another by another process, and no hard and fast line should be drawn. If the sewage cannot percolate into the concrete, it cannot destroy it, and the data of Mr. Hughes' paper showed the exceeding rapidity with which pipe will become impervious. I have been amazed to find the extreme rapidity with which concrete will cease to be permeable after a few months of service. I believe concrete pipe is thoroughly practicable and reliable both for storm and sanitary purposes.

REPORT BY COMMITTEE ON TRAFFIC ON STREETS AND ROADS

Records of traffic on streets are of great importance and utility, as is known to all engineers connected with their construction, maintenance and use. The quantity and weight of traffic on a street or road has generally been one of conjecture and not based on actual count. A traffic regarded in small cities as numerous and heavy, is light traffic in larger ones; although in both places it passes over the same kind of pavement and is under other similar conditions. Although the engineers of the Department of Bridges and Roads of France, who have charge of construction and maintenance of streets and roads of that country, have for fifty years recorded traffic and reduced it to the quantity per meter of width; there has been comparatively little done in other countries. London, Berlin and a few other European cities have taken some records. In the United States it was not until 1885 that records were taken on a few streets of ten cities; more for the purpose of promoting a special class of pavement, then little used, than to determine the relation of quantity of traffic to wear, cost of maintenance of pavements and other important factors. Since 1900, records of various kinds have been made at a few places in several cities, as the importance and great cost of pavement and road construction, and especially maintenance, have been recognized.

There is, as yet, no standard method for recording and comparing the traffic on different streets of a city; nor traffic on streets of one city with those of another. The object of this report is to suggest a uniform method of recording, analyzing and standardizing quantity and weight of traffic on streets and roads, and for reducing it to unit bases of quantity and of tons per yard of used traffic width of roadway per day; or per square yard of used roadway surface, which is the same thing.

It is wise to recall the two legitimate causes of wear and destruction of pavements. They are traffic and weather, separately and combined. In some cases where traffic is very light and weather severe, weather does the greater damage. In other cases where traffic exceeds a certain minimum (the minimum being different for different kinds of pavements and roads) the traffic is a greater function of wear than weather. But in every case traffic must be considered. Whether or not a pavement has been properly constructed with durable foundation and a wearing surface of any one of the many kinds in use and the pavement properly maintained or not, traffic records give very important data on which to base the selection of future pavements, to estimate the value of first construction and the cost of maintenance.

Traffic records not only show what kinds of pavements are most economical from the standpoint of durability and maintenance, but also show the approximate cost of maintaining the kinds of pavements which add to the comfort and health of people using them or living near them, aside from the factor of durability.

Traffic records are also essential to handling traffic and to effective city planning and administration. They show how to relieve traffic congestion by constructing new thoroughfares and their relations to old ones; what streets must be widened; what streets can have their roadways made narrower to reduce cost of paving, street cleaning and for beautifying them by parkways and otherwise.

This report is based on official traffic records of several European and American cities, made at various intervals during the past thirty-nine years and on other documents; supplemented by personal knowlege of many of the streets of these cities and experience in making actual traffic records.

The various and widely divergent analytical records, made in the past few years at a few points in the United States, have been consulted. Most of these records have failed to state the width of the streets or roads and are defective in other respects. Many cannot be reduced to any unit basis for comparison with each other. Many have unnecessarily subdivided the vehicles into too many kinds, sizes, etc., by methods which are complicated and unnecessary for practical, general use.

Traffic records should be based on a simple, accurate method of counting and recording traffic and reducing it to standard units of quantity and tonnage. The method should be such as to be quickly understood and applied. This report presents such method with forms for practical use.

The period during which traffic should be counted is for twelve consectutive hours from 7 a.m. to 7 p.m. and during six consecutive or other different week-days. If average weather and what is known to be average traffic conditions are selected, then a record for only three consecutive week-days gives valuable information. No traffic should be counted in abnormal seasons of snow and ice, nor during continuous rainy, very cold or excessively hot days. The foregoing applies to all cities. Nevertheless, local special conditions on a few principal thoroughfares of cities, say above 500,000 inhabitants, sometimes require records of traffic during the twenty-four consecutive hours of each day for several days. The location where the traffic is counted must be at or near the center of a block and not at an intersection of two streets. The traffic is that which passes both ways along the street or road. It can be counted from the sidewalk or other convenient location; best from a room with window facing the street.

In order to determine the total traffic on a street or road and so tabulate it that the results can be reduced to standard bases, and do this at least possible expense and by simplest method, certain items or factors must be carefully noted as shown in the accompanying forms.

The general classification of vehicle traffic, for practical results, is as follows: First, *horse vehicles;* subdivided into three divisions; having one horse, two horses, three or more horses; Second, *auto vehicles.*

The vehicles and horses must both be considered in computing the weights, etc., of traffic from the quantities counted and recorded. This is because they both occupy space on a roadway and both help wear and injure the surface. Experience has shown that for general traffic counting and the reduction of the quantities of vehicles to tonnage of traffic, the average weight of all vehicles (empty and loaded) drawn by one horse can be taken as one ton of 2000 pounds; by two horses as 2 tons; by three or more horses as 4 tons. In like manner the average of all auto-vehicles (loaded and empty) for transportation of persons and goods can be taken as 1¾ tons. All bicycles and ridden horses, because light and very few, are best omitted from street traffic recording. If ridden horses are at all numerous on a park, suburban or country road, they are best recorded and estimated as one-horse vehicles

Unusual subdivision of vehicles into sizes and kinds, also street cars on their rails and other data, in special cases, can be recorded on separate slips. But this adds greatly to the difficulty of recording correctly and seldom furnishes any needed or practical information as far as streets themselves are concerned.

The forms for counting and recording traffic, hereto attached, are self-explanatory. They should be explained and distributed in advance to the traffic observers or recorders.

FORM I. TRAFFIC RECORDING SLIPS

This consists, as shown, of sets of four cardboard slips, about 9 by 2 inches, fastened together at the end. Twelve sets are needed. One set is used for each hour. But if traffic is very numerous, one or more extra sets can be used for one hour. Each set is marked for location where traffic is counted, name of observer, date, the hour represented by the set (as 7 a.m. to 8 a.m., etc.). There must be at least two observers for each location, to relieve each other at the end of each hour or two hours, because one recorder cannot work accurately for a longer period. An ordinary conductor's punch is needed and a hole is punched in a slip for each vehicle passing in either direction along the street in front of the recorder. One-horse vehicles are punched in the white cardboard; two-horse in the yellow; three and more horse vehicles in the red; all auto vehicles are punched in the blue slips. The number of holes in each are not counted until after a recorder stops observing the traffic. He can count the holes when relieved by the other recorder or at the close of the day's work. On counting he should write on each slip the total number of holes in it.

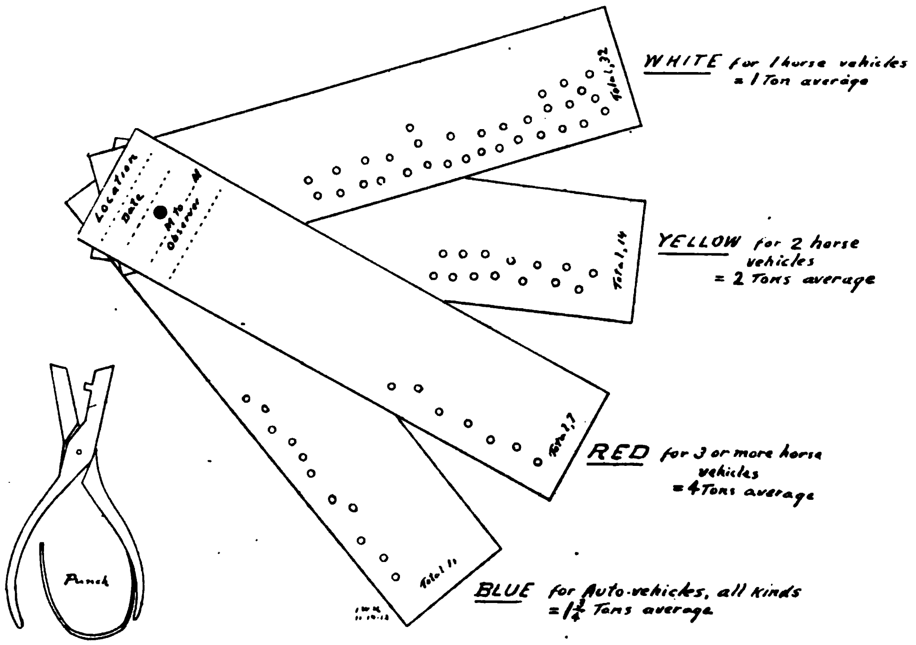
FORM II. ONE DAY TRAFFIC RECORD

This consists, as shown, of a consolidated record of the quantity of traffic during each of the twelve hours from 7 a.m. to 7 p.m., with totals and reductions to unit bases. It gives details of name of city, width of roadway, effective width used by traffic (which averages ½ yard less on each side or 1 yard less than the full width between curbs or edges of the street). The kind and quality of pavements; the weather and other needed facts are shown. This form reduces the one day's traffic to standard units which are

FORM I

TRAFFIC RECORDING SLIPS

CARD BOARD



FORM II

One day traffic record

12 hours from 7 a.m. to 7 p.m. Date..................19.. Day of week...............
City.................... State....................
Location of observer, on............St. (or Ave.) bet..................St. (or Ave.) and................St. (or Ave.)
Width of roadway between curbs at place of observation................yds.
Effective traffic width (1 yd. less than full width).................yds.
Kind of pavement; stone block......................; sheet asphalt......................; or......................
Quality of surface of pavement; new and even............; old and slightly uneven..........; very uneven..........
Condition of surface of pavement; wet..............; dry.............; dirty...............; clean................
Weather; rain..................; fog..................; dry...................; approx. temp.................... °F.
Street car rails present; single track...................; double track...................
General kind of rail; flat with groove....................; ell.....................; tee shape......................
Average approximate speed of horse vehicles..........m. per hr.
Average approximate speed of auto vehicles..........m. per hr.
Remarks:..

Between hours	Number of horse vehicles			Total horse vehicles	Total auto vehicles	Total tons, horse vehicles	Total tons, auto vehicles	Total number all vehicles	Total tons, all vehicles	Total vehicles per yard effective width	Total tons per yard effective width
	1-horse	2-horse	3 or more horse								
7 a.m. to 8.a.m.											
8 a.m. to 9 a.m.											
9 a.m. to 10 a.m.											
10 a.m. to 11 a.m.											
11 a.m. to 12 m.											
12 m. to 1 p.m.											
1 p.m. to 2 p.m.											
2 p.m. to 3 p.m.											
3 p.m. to 4 p.m.											
4 p.m. to 5 p.m.											
5 p.m. to 6 p.m.											
6 p.m. to 7 p.m.											
Totals for 12 hrs.											

NOTE: 1-horse vehicles average 1 ton
2-horse vehicles average 2 tons
3 or more horse vehicles average 4 tons
Auto vehicles average 1¾ tons

Signatures of observers.

....
....
....
....

FORM III

Final consolidated traffic record

Period observed.............days of 12 hrs. each, 7 a.m. to 7 p.m. Date...............19.... Days of week...........
City...................State...................
Location of observer, on...............St. (or Ave) bet.................St. (or Ave.) and.............St. (or Ave.)
Width of roadway bet. curbs at place of observation..........yds.
Effective traffic width (1 yd. less than full width)................yds.
Kind of pavement; stone block..........; sheet asphalt.........; or ....
Quality of surface of pavement; new and even..........; old and slightly uneven..........; very uneven............
Condition of surface of pavement; wet...............; dry...............; dirty...............; clean............
Weather; rain.................; fog.................; dry..................; approx. temp.................. °F.
Remarks..

Days	Total number of vehicles		Total tons horse vehicles	Total tons auto vehicles	Total number all vehicles	Total tons all vehicles	Total vehicles per yard effective width	Total tons per yard effective width
	horse	auto						
First day..........								
Second day........								
Third day.........								
Fourth day........								
Fifth day..........								
Sixth day.........								
Totals..........								
Average per day of 12 hrs.........								

Compiled by: ....

the total vehicles and total tons of traffic on the whole street; also per yard of effective width of the street. This is the equivalent of number of vehicles and tons per square yard of used roadway surface.

FORM III. CONSOLIDATED TRAFFIC RECORD

This form, as shown, is compiled from records on several Forms II. It consists of a condensed statement covering the six or other number of day's traffic. It shows the data day by day together with the final totals and the averages per day. These totals are reduced to tons to the standard unit of yard of effective width (square yard) of roadway surface subjected to the traffic. These are the true bases for comparing the traffic of one street with another and for establishing the relation of different amounts of traffic to wear on pavements, cost of maintenance and for many other useful purposes.

Traffic records are seldom needed annually; but at longer intervals up to once in five years or according to local changes of traffic conditions and other necessities in cities, counties or states.

In connection with the foregoing description of how traffic can be simply and accurately recorded and reduced to standards of quantity and of tons per yard width of roadway, the following actual records of traffic in various representative cities and on a few suburban and country roads, will aid in establishing a basis showing the various degrees of intensity of traffic: First, very light; second, light; third, moderate; fourth, heavy; fifth, very heavy; sixth, extra heavy.

These quantities are compiled and computed from old official and later traffic records and are excellent illustrations of quantities, tonnage and degrees of intensity of traffic per yard of effective width of used roadways. In many cases the records were made in such different ways and without proper classification of vehicles, that the data, in such cases, was not sufficient to supply the omissions, indicated in the table by (x). The traffic is the average of several day's of twelve hours from 7 a.m. to 7 p.m. or, in a very few cases, a close approximation.

As soon as cities, counties and states have recorded, tabulated and reduced the traffic on their roadways, on the standard bases

Records of Traffic Reduced to a Common Basis

Place	Street	Totals on whole width of roadway		Total per yard effective width of roadway		Relative intensity or degree of traffic
		Vehicles	Tons	Vehicles	Tons	
Paris	Rivoli St.	33,232	49,041	2,767	4,087	Sixth
Paris	Opera Av.	29,460	42,216	1,789	2,558	Sixth
Paris	Madeline Bl.	17,524	24,776	1,019	1,385	Sixth
Paris	Italiens Bl.	20,124	27,651	1,093	1,500	Sixth
Paris	St. Honore St.	16,598	22,952	1,976	2,732	Sixth
Berlin	Potsdam Pl.	14,221	39,656	1,016	2,832	Sixth
Berlin	Leipzig St.	9,596	26,139	720	1,961	Sixth
Berlin	Friederichs Pl.	13,479	33,529	963	2,395	Sixth
London	Strand	16,208	27,878	1,430	2,460	Sixth
London	Cheapside	11,019	18,953	1,136	1,954	Sixth
London	Gracechurch St.	12,148	20,894	1,149	2,154	Sixth
New York	5th Av. nr. 58th St.	8,665	12,091	673	946	Fifth
New York	First Av.	2,301	3,391	131	192	Third
New York	Bway. nr. Fkln.	3,277	3,554	266	288	Fourth
New York	Wall St.	2,443	3,555	305	444	Fourth
New York (Queens Borough)	Hillside Av.	1,304	1,529	157	184	Third
New York (Bronx Borough)	White Plains Rd.	342	536	49	75	First

Washington	Fifteenth St.	4,687	6,456	335	461	Fourth
Washington	Ninth St.	1,965	2,478	123	155	Third
Chicago	State St.	6,048	(x)	430	(x)	Fourth
Chicago	Clark St.	4,691	7,728	335	552	Fourth
Chicago	Wabash Av.	3,794	8,643	237	590	Fourth
Chicago	Sheridan Rd.	5,736	11,925	465	994	Fifth
Philadelphia	Broad St. nr. Chestnut	6,176	11,154	105	697	Fifth
Philadelphia	Filbert St.	5 185	8,102	576	900	Fifth
St. Louis	Locust St.	3,496	5,308	318	482	Fourth
St. Louis	Broadway	3,150	4,976	197	311	Fourth
Buffalo	Main St.	2,941	3,836	166	217	Third
Buffalo	Linwood Av.	697	1,541	60	129	Second
Boston	Devonshire	5,410	7,380	676	923	Fifth
Boston	Kirby St.	3,503	4,555	455	591	Fourth
Newark	Broad St.	2,400	(x)	126	(x)	Third
Newark	Bridge St.	2,522	(x)	205	(x)	Fourth
Massachusetts	Shrewsbury Rd.	484	770	97	154	Second
Massachusetts	Medford Rd.	434	669	47	72	First
Massachusetts	Weston Rd.	964	1,260	161	210	Third
Rhode Island	E. Providence Rd.	463	172	77	112	Second

and units set forth in this report, then they will have accumulated very valuable data for comparing the results between the streets and roads of the same and other places. This information will be of much assistance thereafter in economically and efficiently solving all problems connected with the construction and use of all arteries of public travel and transportation, used by horse and auto vehicles.

James W. Howard, *Chairman*,
Isaac Van Trump,
C. G. Anderson.

DISCUSSION

Mr. Warren: It is a matter of great importance, not only to take the traffic records, but to take them on some uniformly standardized basis. The few traffic records we have are generally taken by the engineer or contractor on some form he may have in his mind, and which provides no uniform basis of comparison of one street with another, or the streets of one city with the streets in another. I have here a form that has been adopted in connection with the different organizations I have been interested in from time to time the last twenty-five years, which we think is very good. There is such a thing as going too much into particulars. If there is any criticism of Mr. Howard's form it is along that line. As the paper point out, it is important to take the record at uniform hours of the day. For ordinary observation, a record of twelve hours, seven in the morning to seven in the evening, takes the great bulk of the traffic during the day, and provides a fair basis for comparison. This form I will leave with the secretary. I think it has an advantage over some of the forms suggested, in that it is a little more simple. It is difficult on a heavy traffic street to take the record and sub-divide it as much as it is sub-divided there. This is a subject that municipal officials and people interested in street matters should take up, and the records should be taken systematically and on some uniform standard form.

REPORT OF RECORD OF TRAFFIC

From 7 a.m. to 7 p.m.,..........
City...Population..............................
.... {Street / Avenue} between..................and....................
Width of street............feet. Number of street car tracks.......................
Street now paved with..Business or residence?........
....Is traffic likely to materially increase if smooth pavement is laid?.............
Is street a thoroughfare or likely to become one if smooth pavement is laid?.....................
Are adjacent parallel streets improved?........If so, state kind of pavement and condition......

	Number of vehicles	Number of tons
Pleasure vehicles, estimated at ½ ton each		
One-horse trucks, light, " " 1 " "		
" " " loaded, " " 2 " "		
Two-horse " light, " " 1½ " "		
" " " loaded, " " 3½ " "		
Extra heavily loaded trucks, " 5 " "		
Automobiles, light, " 1 " "		
" heavy, " 2 " "		
Totals		

Tons per foot in width of roadway between curbs..
" " " " " " less width of tracks..
Signed........................

The President: We are glad to have this report and the remarks from Mr. Warren, because this has not been gone into as thoroughly by engineers and municipal officials as it should be. We should begin to look towards standardizing this matter of street traffic censuses.

Mr. Hallock: Thoroughy agreeing with Mr. Warren on some of his statements, I disagree with him as to his form. I used it for some time, and the complaint was made that his form was too complex—that on a heavy traffic street it was impossible to make a definite record. We doubled the number of recorders, placed them on opposite sides of the street, but they could not check. Mr. Howard uses but four sub-divisions, while Mr. Warren makes a division between light and loaded, etc., and he classifies them so that the recorders have a great deal of trouble with them. I found they were losing sight of the number of horses on the wagons. On wagons with high sides, they were in doubt whether they were loaded or empty. I think Mr. Howard's division is better. Mr. Warren also provides for some information not of great interest to the engineer, but of interest to the contractor who desires to repave a street, and it complicates the record in some degree.

THE EFFECT OF TRAFFIC ON BITUMINOUS PAVEMENTS

By ISAAC VAN TRUMP

Considering the important part traffic plays with reference to the life and serviceability of an asphalt pavement, it is remarkable what little attention is given to this very important feature. It is still the custom in many localities to employ an asphaltic cement of uniform consistency throughout the entire season, regardless whether the street is broad or narrow or whether the traffic thereon is very light or very heavy.

This is anything but a scientific and intelligent method of building a street and, as a result, many lightly traveled thoroughfares have cracked because the wearing surface was too hard while on the other hand many heavily traveled streets have rutted and marked because the surface mixture was too yielding to support a large volume of traffic. Both these conditions can largely be overcome by giving, prior to the laying of the asphalt surface, careful consideration to the probable volume and character of traffic the improved thoroughfare is to accommodate. This can usually be closely estimated by carefully noting the condition of adjacent parallel streets and by observing whether the improved street will divert traffic from some main artery of travel, for many thoroughfares carrying light traffic before being improved are converted into moderately heavy traveled streets after improvement.

A new problem has arisen within the past year or two which the paving engineer must solve and that is the deep ruts formed in bituminous roadways under exceedingly heavy motor traffic. The writer has in mind two boulevards, paved about twelve years ago with sheet asphalt. Until less than two years ago these thoroughfares were, after eleven years of constant traffic, still in perfect condition. During the summer of 1911 slight ruts appeared in the pavement, gradually becoming deeper until during the past hot season it became almost dangerous for a fast moving vehicle to use that portion of the street. In the writer's opinion, this pavement which had for eleven years been perfectly hard and stable gradually became softened and displaced under the tremendously increasing automobile traffic and the minute oil drippings from same. It has been estimated that upward of 17,000 vehicles, principally automobiles, pass over these pavements each day of twenty-four hours, a large percentage of which are homeward bound between the hours of 4 and 7 p.m., when the pavement, especially during the summer, is still warm and yielding from the hot sun.

It is, of course, well known that asphalt pavements become harder with age but on the two boulevards above mentioned the condition of the pavement after years of service is reversed and it is now the problem of the paving engineer to prepare and lay a bituminous pavement which will not be seriously affected by the minute but constant dripping of oil and gasolene from automobiles which are rapidly increasing in numbers and weight each year. Neither is the above condition confined to sheet asphalt alone as a similar condition existed on another portion of one of these same boulevards, paved with bituminous concrete containing a coal-tar binder in 1907. Deep ruts appeared in this pavement within two years after laying, making it necessary to re-surface the entire roadway.

Apparently for the purpose of obtaining a slight reduction in the first cost of asphalt pavements, some few municipalities are advocating the elimination of the binder course. In many instances, to economize in this manner is a serious mistake. On thoroughfares where the traffic is medium to heavy, a sheet asphalt pavement or even the fine stone asphaltic concrete wearing surfaces now being laid in many localities, will frequently creep and shove alarmingly when laid directly upon the cement concrete base as usually constructed. This base is more or less dusty and offers no anchorage whatever to the wearing surface. On the other hand, a dense binder composed of about two-thirds broken stone and one-third sand and containing a minimum of voids not only acts as an anchor for the wearing surface by giving added rigidity and stability to it but it also protects the upper surface to a considerable degree from the deleterious action of water and illuminating gas from beneath. Many concrete foundations exude moisture under certain atmospheric conditions. The opportunity for street liquids to get beneath the pavements from along car-tracks, gutters and headers and around man-holes and catch-basins is great. Where no binder is employed, these liquids have easy access to the under side of the wearing surface. Therefore the decided advantage of a properly constructed binder course can be readily appreciated.

To prevent the wearing surface from creeping under traffic, some municipalities substitute a paint coat in place of a binder course between the concrete base and the surface mixture. Theoretically, a paint coat forms a perfect bond between the two courses but at best it is difficult and inconvenient to prepare and apply and unless the conditions on the street are ideal the practical results are frequently entirely different from those obtained in theory.

Also for the purpose of overcoming the tendency of the wearing surface to shove under traffic, several cities have recently adopted what is known as "Anchor concrete," a form of construction patented by W. B. Brady, a well known paving man of Chicago. Anchor concrete is merely a slush coat of cement mortar spread ½ inch deep upon the freshly laid concrete foundation. Before this slush coat has received its initial set, clean, hard, broken stone about 1½ to 2 inches in diameter is spread evenly over it and imbedded into the slush coat by light tamping. When dry, this produces a very rough but rigid surface and acts as an anchor for the topping which is laid directly upon it. This form of construction is especially effective on steep grades.

Where the traffic is light, such as on suburban or residential streets, it may be possible to eliminate all forms of intermediate courses and lay the wearing surface directly on the concrete base; but to do away with the binder course generally, as a few municipalities have recently done, regardless of traffic or other conditions is, in the writer's opinion based on many years' experience in this and foreign countries, a serious error.

TESTING BITUMENS

By ISAAC VAN TRUMP, *Engineering Chemist*

While revising, recently, a number of so-called standardized paving specifications we were surprised to note the wide discrepancies in them with reference to the various methods of testing bitumens. Further investigation along these lines convinced us that very little attention has apparently been given to this important feature; that few specifications agree as to a standard method of obtaining the melting point, loss on evaporation, solubility in napththa and carbon tetrachloride, ductility, flash, etc.

There are probably a dozen different methods of obtaining the melting point of solid bitumens in use in the various asphalt testing laboratories throughout the country, with results varying as much as 40° to 50° F. Of these numerous methods, probably the most popular at present is the cube method adopted by the United States Office of Public Roads, American Society of Civil Engineers and others; but this method, while generally satisfactory, is unreliable when testing high melting point bitumens, inasmuch as the wire on which the half-inch cube is placed becomes so hot as to cut through the bitumen before the latter has sufficiently softened to lose its cubical shape. All the other melting point methods also have some minor drawback but the principal fault is that no one standard method has been adopted and as a result the term "melting point" in a specification means little or nothing. The consistency, fixed carbon, specific gravity, etc., are understood because they are respectively obtained in one definite manner but the other characteristics previously mentioned are, accurately speaking, still unknown quantities because no uniform method of obtaining them has been adopted.

The loss by evaporation is also arrived at by several means. While the manipulation is practically the same in all laboratories no definite sized vessel has been adopted as standard. Not only does the diameter of the container, but the height as well, materially affect the results, as also does the quantity of bitumen used'

Many specifications merely specify that 20 grams of the material shall be tested in a tin box 2½ inches in diameter, making no mention as to the depth of the vessel; but when testing a soft or a highly volatile bitumen, 20 grams in a vessel of this size would be insufficient for penetrating after heating, so 50 grams would appear to be a more desirable quantity to use. On the other hand, 50 grams of some of the lighter bitumens could not be conveniently tested in a vessel as small as 6 centimeters wide and but 2 centimeters deep, as is required by some specifications.

Any form oven that will give a uniform temperature throughout all parts where the samples are placed can be used, but at least two thermometers should be employed, the bulb of one being immersed in a blank sample of some non-volatile fluid bitumen to register the exact temperature of the samples during the test and the other is kept in the air in the oven, at the same level as the first, to give warning of any sudden change in the temperature due to irregular gas pressure, etc. This custom is not followed in many laboratories because of the lack of a uniform method of making this test.

The method for determining the bitumen insoluble in naphtha should be standardized by stating the gravity and character of the solvent used. Many specifications merely specify "Standard petroleum naphtha," which may mean any petroleum naphtha possessing a gravity between 62° and 88°. However, as petroleum naphthas are by no means definite compounds, their solvent powers varying greatly, it is doubtful if an absolutely standard solvent can be specified, but efforts to that end should be attempted.

In determining the bitumen soluble in carbon tetrachloride, experience has taught us that to secure the most accurate results this test should not be made in a light place and that the solvent should be permitted to act upon the bitumen several hours, preferably over night and in a dark place, before filtering. Unfortunately, this precautionary measure is not always specified and the results are frequently extremely inaccurate.

The Dow method for determining the ductility of solid bitumens is well known and is generally accepted by engineers and chemists as the standard method. It requires a briquette of the bitumen, having a definite shape and cross section, to be elongated at the rate of five centimeters per minute at 77° F. Because of the lack of uniform methods, the second largest city in the United States employs a much faster rate of elongation, 60 centimeters per minute being specified in that city. Naturally, the results are much lower than when the usual method is employed, imposing an extra hardship on the producers and consumers of asphalt used in that city and causing considerable confusion in the minds of many of those affected who are not entirely familiar with the significance of the faster method.

As before stated, uniform methods for determining the penetration, fixed carbon, specific gravity, etc., have already been adopted by the asphalt paving industry and it is for the purpose of standardizing the other tests on asphalts and bitumens that we present this subject to the members of the American Society of Municipal Improvements for discussion, with the respectful suggestion that our President appoint committees for the purpose of standardizing methods of testing *all* materials entering into municipal improvements.

THERMAL EFFECTS ON CEMENT-FILLED BRICK PAVEMENTS

By JAMES E. HOWARD, *Engineer-Physicist, Bureau of Standards*

An ideal street pavement is one which presents a smooth surface of such hardness and rigidity that the tractive effort of moving vehicles is reduced to a minimum; having a surface smooth, without slipperiness; of adequate frictional properties for the safe footing of men and animals and against the skidding of motor-driven vehicles; durable against abrasive wear, and of sufficient compression strength or sustaining power against concentrated wheel and toe-calk loads; one in which the physical properties are not materially modified by the usual range of atmospheric temperatures and which is practically non-absorbent and impervious to moisture. These conditions are generally met in a pavement of vitrified brick of monolithic construction, the continuity of which is attained by means of cement-filled joints.

If not confronted with destructive tendencies incident to changes in dimensions caused by changes in temperature, there is apparently no reason why a well constructed brick pavement should not maintain a state of integrity and successfully endure traffic conditions for many decades of years. The principles of road construction are generally understood and practised and at times there is close approach to attaining results which are not expected to be surpassed.

An inquiry into the effects of changes in temperature on cement-filled brick pavements is an inquiry of a refined order; taking up the subject at an advanced stage, from a constructional point of view, but nevertheless involving questions of vital importance, the solution or adjustment of which will promote the success of this type of pavement and contribute toward securing that permanency which is desired.

Referring to the physical properties of vitrified paving brick, the crushing strength commonly ranges from 10,000 to 15,000 pounds per square inch, not infrequently reaching and exceeding 20,000 pounds per square inch. The compressive modulus of elasticity is found to range ordinarily from 2,500,000 to 8,000,000 pounds per square inch, with a value as high as 10,000,000 pounds per square inch occasionally observed. In building bricks, values below the above mentioned minimum are often displayed. The compressive strength and modulus of elasticity increase as the weight per cubic foot of the bricks increases, while the porosity or rate of absorption of moisture decreases. That is, the more material there is in a given space the stronger and more rigid it is and necessarily less porous. These are features which should be considered in a paving brick and they are features which are controllable in the process of manufacture; at least the apparent modulus of elasticity is modified by the conditions of burning the brick, while the crushing strength and density certainly can be controlled within limits.

As regards the value of the coefficient of expansion of brick, data are not as complete as desired. The values frequently seem to be in the vicinity of 0.0000040 per degree F., with some examples however approaching the values for steels, or above 0.0000060.

A value of 0.0000040 has been accepted for the time being in considering some of the phenomena attached to the expansion of pavements, since this corresponds well with the observations which have been made on the behavior of the pavements.

In regard to the significance of the relation between the modulus of elasticity and the coefficient of expansion in respect to the force which the confined material would develop when raised through a range of temperature of 100° F., taking for examples four mud bricks selected from different parts of a down draft kiln, the following table is presented:

Location in kiln	Modulus of elasticity	Crushing strength	Weight per cu. ft.	Confined stress
	lbs. per sq. in.	*lbs. per sq. in.*	*pounds*	*lbs. per sq. in.*
Top....................	10,000,000	19,170	144.3	4,000
One-quarter down.....	7,692,000	15,670	136.4	3,076
Two-thirds down......	5,263,000	10,420	130.6	2,105
Bottom................	4,545,000	10,870	125.4	1,818

That is, bricks of these moduli of elasticity would be expected to develop, when confined and strictly prevented from expanding, compressive stresses ranging from 1818 to 4000 pounds per square inch.

The bearing which these figures have upon the behavior of cement-filled brick pavements is this: The pavements will develop certain compression stresses when the temperature is raised, which stresses will be greater with brick of high crushing strength with high modulus of elasticity in comparison with those of a lower modulus of elasticity. Only a portion of the possible maximum confined stress will, however, be realized, but the relative expansive force exerted should be proportional to the moduli of elasticity and since the highest values pertain to the strongest brick, those pavements constructed of the strongest material will be capable of exerting the highest stresses which are incident to rise of temperature.

It would in some cases relieve the magnitude and severity of thermal effects to restrict the brick to a grade sufficient to provide adequate abrasive resistance for traffic conditions of a particular street. The endurance of brick pavements against abrasive wear has been found from experience to be so great that no trouble is ordinarily apprehended in that direction. It is believed therefore that the selection of the bricks and modifications in the manner of laying the pavement, tending to ameliorate thermal effects, are matters deserving consideration.

The observed expansion of cement-filled pavements, in a direction crosswise the roadway, has corresponded closely to a coefficient of expansion of 0.0000040 per degree F. In the following table, however, the computed expansion of roadways of different widths is given for a range of temperature of 100° F. for assumed coefficients both of 0.0000040 and 0.0000060.

Computed expansion of cement-filled brick pavements for a range of tempertures of 100° F.

Width of roadway	Assumed coefficient of expansion	
	0.0000040	0.0000060
	inch	*inch*
4 feet 8 inches	0.0224	0.0336
14 feet	0.0672	0.1008
25 feet	0.1200	0.1800
30 feet	0.1440	0.2160
40 feet	0.1920	0.2880
50 feet	0.2400	0.3600

The table gives the total computed expansion, one-half of which might be taken as occurring at each side of the street.

Although the maximum stresses which the confined material could display would range in round numbers from 25,000 to 50,000 pounds per individual brick, yet the street curbing could not ordinarily afford any such reaction. Curbing which is backed up by earth filling yields to moderate pressures when they are long sustained, and in a crosswise direction pavements would not be expected to develop forces of very great magnitude in the absence of substantial buttresses. The fact that the middle of roadways rises during the period when the bricks reach a high summer temperature is occasioned and facilitated by the crowning of the roadway. The usual pavement is, in transverse section, a bent column, of very slender proportions which easily rises, increasing the crowning of the arch and may result in the formation of longitudinal cracks.

Referring to observations which have been made on pavements in Cleveland, O., and vicinity, covering a period of a few months over a year, they have embraced measurements on thermal effects, in which attention has been directed to changes in lengths taken both lengthwise and crosswise the roadways. Reference lengths of 20 inches each were established and defined by means of small bronze plugs inserted in the pavement. The tops of the plugs were about ⅜ inch below the surface of the pavement and protected against traffic by paper washers and putty. These plugs had in their upper ends small drilled and conically reamed holes, from center to center of which measurements were made.

A strain gauge of the style shown by figure 1 was used for measuring purposes. Generally the readings of the guages checked to a ten thousandth of an inch, although that degree of accuracy will not be claimed for the work. It is believed, however, that changes in the reference lengths were measured, reliable within two ten thousandths of an inch. A steel reference bar is used in connection with the strain gauge. The comparatively short gauged lengths of 20 inches each are preferred instead of longer ones for inquiries of this kind where specific and detailed information is sought on the behavior of the pavements.

In addition to the measurements with the strain gauge on changes in dimensions due to changes in temperatures, the work at Cleveland included a number of observations on the elastic depression of loaded pavements and the depression of trolley tracks under the weights of cars. Figure 2 illustrates the method of measuring the depression of trolley tracks by means of a levelling beam. One end of the beam rested upon the track the other end, 4 or 7 feet away, upon the pavement. The beam is provided with a sensitive level and micrometer elevating screw. There is a general depression of the pavement and roadbed in the vicinity of a car, but slight in amount when compared with the depression of ordinary trolley track. The depression of trolley track usually takes place to such an extent as to make it undesirable to bond the pavement to it. When a very sensitive level bubble was used the depression of the pavement could be detected some ten feet from a trolley car in the direction of the curbstone. This was found on a tar-filled pavement.

At an intersection the approach of a man when 12 feet distant was indicated by this sensitive level. Monolithic brick pavements are very elastic. They depress locally under loads and spring back when released.

In conjunction with the measurements of changes in the 20-inch reference lengths, there were observations on the incipient formation of transverse cracks in freshly grouted pavements. Figure 3 illustrates some dark lines which developed in a freshly grouted pavement, the photograph showing their appearance before the street was opened to traffic. These dark hair lines are taken to represent cracks in an early stage of development. Incipient cracks appear at first as fine dark lines, darkened apparently by the presence of moisture. Later the lines are white, caused probably by the lime in the cement of the grout going into solution and then being converted into the carbonate. These phases have been observed, although they may not be conspicuous in all cases.

The first twenty-four to forty-eight hours after grouting is a critical period in the laying of a cement-filled pavement. The grout during the first few hours after applying has very little strength, and like cement structures in general it cannot safely be disturbed during the period of setting. A drop in temperature of the brick work of 30 degrees from day to night is not uncommon. An uncovered pavement can hardly endure this drop in temperature without starting incipient cracks. A thin layer of sand on the

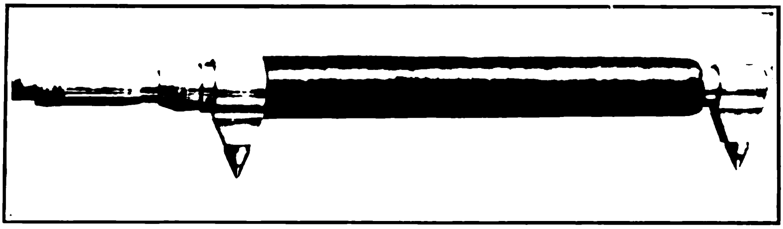


Fig. 1. Strain Gauge Used in Measuring Thermal Effects on Street Pavements

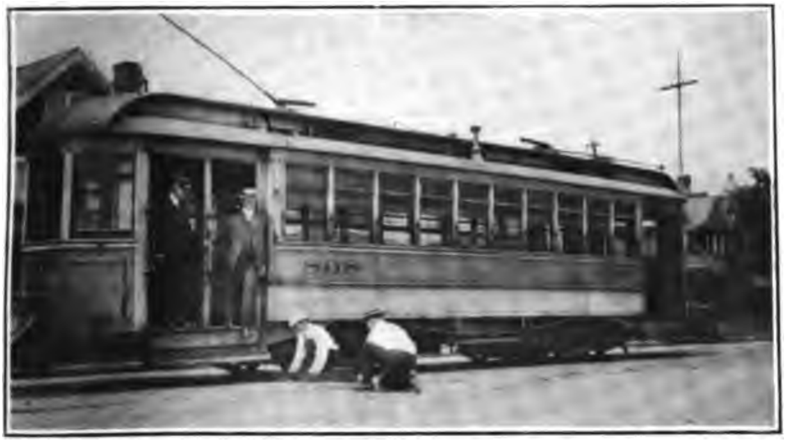


Fig. 2. Measuring Depression of Trolley Tracks by Means of Leveling Beam

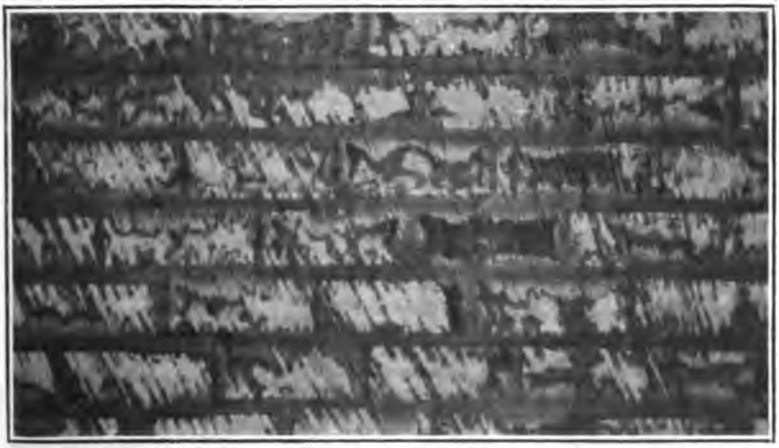


Fig. 3. Dark Lines in Grouted Joints Representing Cracks in Early Stages of Development, Prior to Opening Street to Traffic

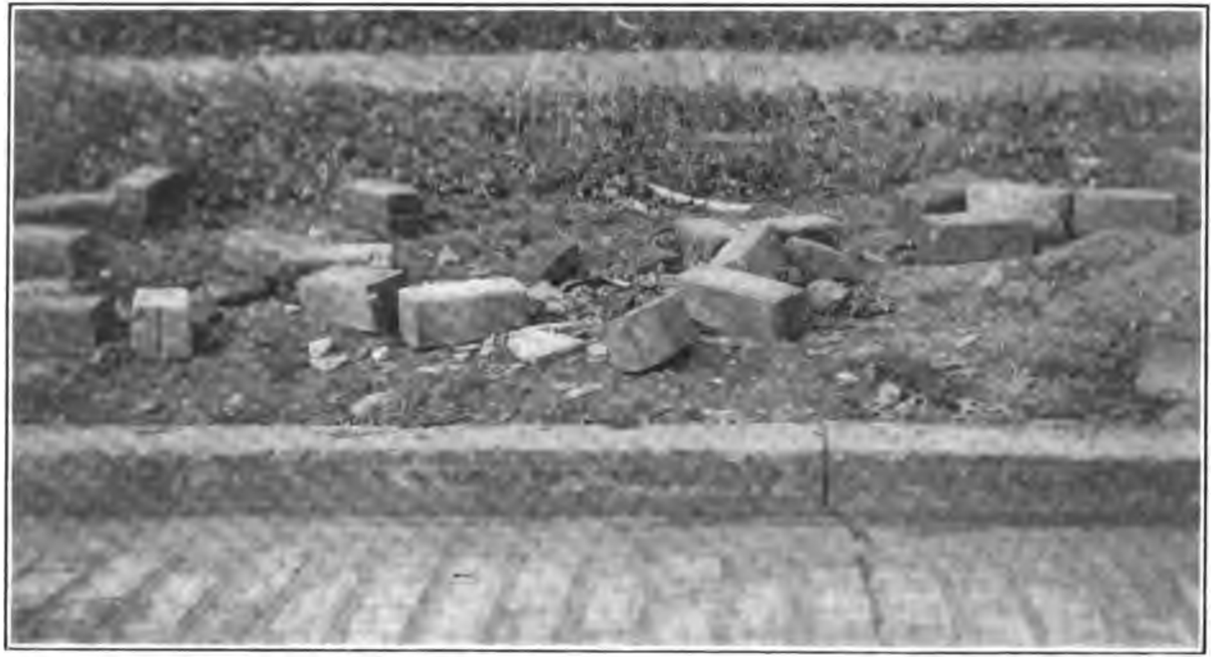


FIG. 4. TRANSVERSE PAVEMENT CRACK OPPOSITE END JOINT OF CURBSTONE

Location of crack attributed to contraction of edgestones.

pavement aids somewhat against the joints being put into a state of tension by the lower temperature of the night. It is probably quite impracticable to use a sufficiently deep layer of sand to entirely protect the pavement against this drop in temperature, while the grout is acquiring strength.

It would seem that a period of favorable weather conditions would be met, for monolithic pavement construction, when minimum diurnal changes in temperature prevail immediately following the time of grouting. Cement users are well aware of the necessity of keeping the cement quiescent during the period of setting, and the same necessity exists in the case of grouted pavements as in other kinds of cement work. The extent of the surface exposed in a pavement precludes the adoption of means which would be practicable and adequate to avoid excessive thermal strains in certain other engineering examples. It is safe to say that thermal cracks must be recognized as a probability and their presence expected, and that they may have their origin in point of time prior to the opening of the street to traffic.

Figure 4 shows a transverse crack in a pavement opposite the end joint of the curbstones. This street did not have an expansion joint, hence there was at least considerable frictional resistance between the pavement and the curbstones. The diurnal expansion and contraction of the curbstones would affect the width of the joint between them. In the case illustrated, the brick followed the movements of the curbstones and a transverse joint in the pavement was developed. The photograph of this crack was taken before the street was opened to traffic. While this street in Lakewood did not have expansion joints at the curb, it will not be understood that streets with expansion joints are exempt from transverse cracks due to early changes in temperature. Observations tend to prove that such cracks are of common occurrence.

There seems a progressive development in these early transverse cracks, which first appear as fine hair lines and eventually have a measurable width. The presence of a number of such transverse cracks (and commonly quite a number are formed) leads to a lengthening of the pavement as a whole. The pavement of Andrews avenue in ten months' time had extended in one direction and crowded over the marginal curb at the crossing of the tracks of the N. Y. C. & St. L. R. R. about $\frac{5}{8}$ inch, and in the other direction had crowded the asphalt pavement of Clifton boulevard carrying with it and deflecting the trolley tracks.

Some of the transverse thermal cracks which were developed in the pavement of Farmington road, East Cleveland, were spanned by reference lengths of 20 inches each and the progress of development observed. This street was paved about August 1, 1911. Measurements of reference lengths established on the pavement were taken at intervals during the following months of September, October and November. The measurements of one reference length spanning a transverse crack showed that its development took place as follows:

	Inch
September 22 (initial reading)	0.0
September 30	0.0080
October 23	0.0170
November 9	0.0250
November 13	0.0377

The temperature of the brick on September 22 was about 90° F., while on November 13 it was 32° F. This is an example of a wide crack. A remeasurement on the following August showed the crack very much reduced in width, the temperature then being 82° F.

In the progressive development of a transverse crack there is a probability of its not closing entirely when the pavement subsequently reaches a maximum temperature. Fine particles of sand or abraded material from the surface of the pavement are likely to get swept into the crack during the daily drop in temperature and prevent the closing of the crack when the pavement again reaches a higher temperature. This process will be repeated until the pavement reaches a state of considerable longitudinal compression. The middle part of the length of the street would then remain in a state of more or less initial compression over certain ranges in temperature while the ends, if unresisted, would extend measurably in each direction longitudinally.

That part of the street which is under initial compression longitudinally is for the time being in a firm condition and capable of sustaining traffic satisfactorily. If the cracks are numerous and near together, as shown by an earlier paved street in figure 5, and not under sufficient longitudinal compression, the sections then act

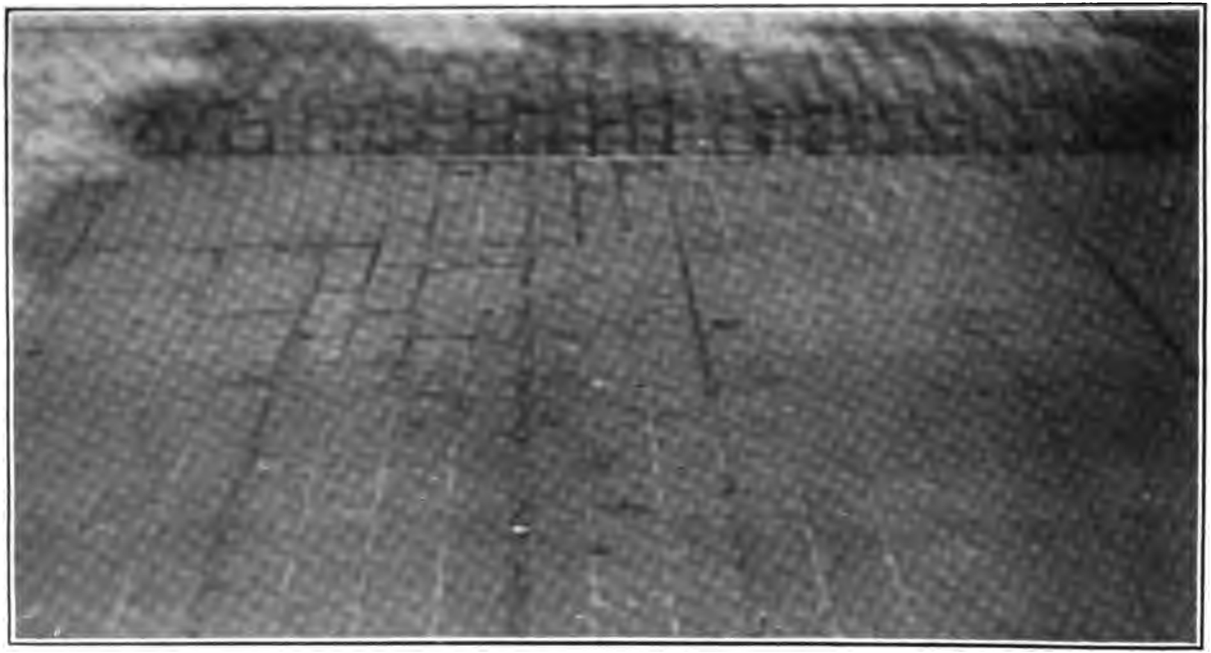


FIG. 5. TRANSVERSE CRACKS IN AN EARLIER PAVED STREET

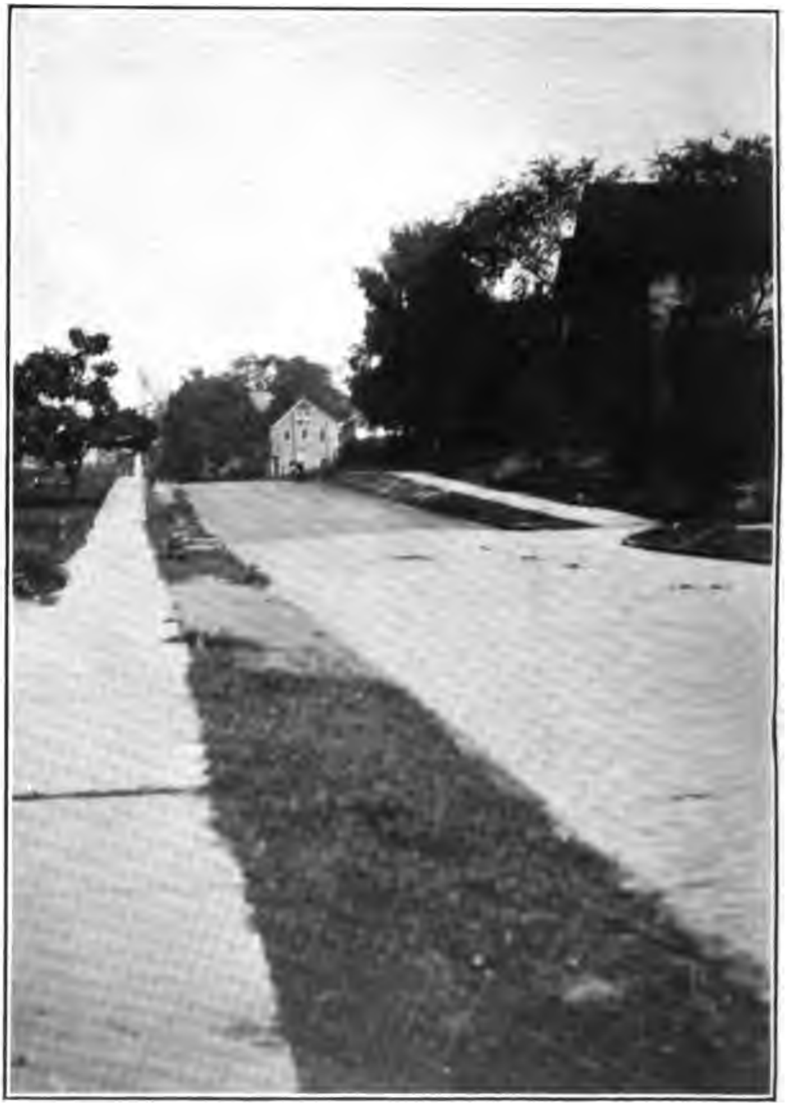


FIG. 6. SECTION OF TAR FILLED PAVEMENT BETWEEN TWO CEMENT FILLED SECTIONS

Tar filled section 150 feet long at top of incline. Expansion joints at curbstones.

independently. When depressed by the load of a vehicle an abrasive action will take place between the cracks and tend to enlarge them.

The pavement is believed to be in a favorable condition when under initial longitudinal compression, and the same would be true of lateral compression if the pavement was flat or had very little crowning. Initial compression as such seems advantageous, or a certain amount is advantageous. This state of compression may be reached and maintained along the middle part of a straight roadway but difficulties are encountered at open ends in providing an adequate marginal curb to resist the thrust.

Curves in the streets present places where the continuity of the pavements is necessarily interrupted and call for special treatment. Intersections do not appear to offer particular difficulties. The forces are balanced at such places, and if the pavement is flat or nearly so the compressive stresses will be easily resisted by the brick. At curves and bends in the street unfavorable conditions are present. The pavements move from the inner curb and are forced against the outer one. Commonly the outer curbstone is displaced by the pressure against it. In a short reversed curve perhaps the most unfavorable conditions prevail and shearing stresses break up the pavement at such places.

Figure 6 is a view of the upper end of Kennedy avenue, Cleveland, O. This street has been paved a year and several months. It is in three sections, the upper and lower ones are cement-filled, while an intermediate section has a tar filler. The tar-filled section is the darker part of the roadway on the photograph, a cement-filled section beyond not showing in this view. This street has expansion joints at the curbs throughout its length. A noticeable feature in the cement-filled parts of the pavement of Kennedy avenue is its creeping toward the low resisting tar-filled section. The lower cement-filled section is travelling up grade toward the tar-filled section and carrying with it a part of the pavement of the driveway entrance, which is shown on the right side of the roadway in figure No. 6; while the upper cement-filled section is compressing the intermediate section in a down grade direction. This compressive force is felt at the ends of the tar-filled section but not at the middle of its length. Along the center line of the roadway the 20-inch reference lengths in the tar-filled section were shortened 0.1155 inch and 0.1968 inch respectively, for the upper and lower ends of the section, between the dates of September 29, 1911, and August 25, 1912.

The travel of the lower cement-filled section, in an upgrade direction as it chanced to be, carrying with it a portion of the pavement of the driveway entrance is shown by figure 7. The portion of the driveway pavement above the zigzag crack was carried along by the general movement of the surface of the roadway.

Figure 8 shows a longitudinal crack along the crown of the roadway, the formation of which is attributed to lateral compression raising the crown and causing a fracture by the crosswise bending of the pavement. While the bricks would be unaffected either by such longitudinal or lateral compression as would result from increase of temperature over atmospheric ranges, still it would require comparatively little force to raise the pavement against its own weight only, starting in a bent condition by reason of the usual crowning given the pavement in its construction.

In the tar-filled section of Kennedy avenue pavement, the joints were partially depleted of the filler through flow of the material. This affected the pavement along the center line of the street, the tar flowing down grade and toward the gutters, where it accumulated.

Figure 9 shows somewhat indistinctly the spalling of the brick in the tar-filled section, by reason of unsupported edges. A cement filler would, of course, afford the necessary support to the edges of the brick and tend to prevent so early destruction of the individual bricks. The traffic on Kennedy avenue is not very great for a city street.

Figure 10 shows the creeping of a brick pavement and its effect upon an abutting asphalt pavement. A ridge in the asphalt was raised and a gas main cover tipped by the movement of the cement-filled brick pavement. The weaker asphalt pavement readily yields to the pressure exerted by the brick pavement, while the latter itself is more or less cracked in that vicinity as it would be at an open end. The creeping of a strong brick pavement disturbs manhole frames and carries along with it catch basin gratings, as shown by figure 11. The pavement of Belmore road, East Cleveland, showed a movement at the place photographed about equal to the width of a brick.

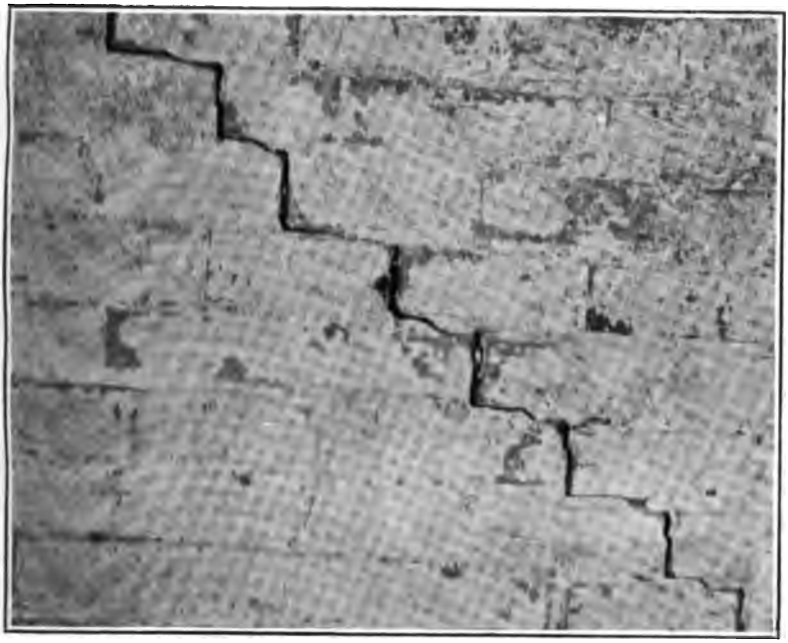


FIG. 7. ZIGZAG CRACK IN DRIVEWAY LEADING FROM CEMENT FILLED SECTION OF PAVEMENT OF FIGURE 6

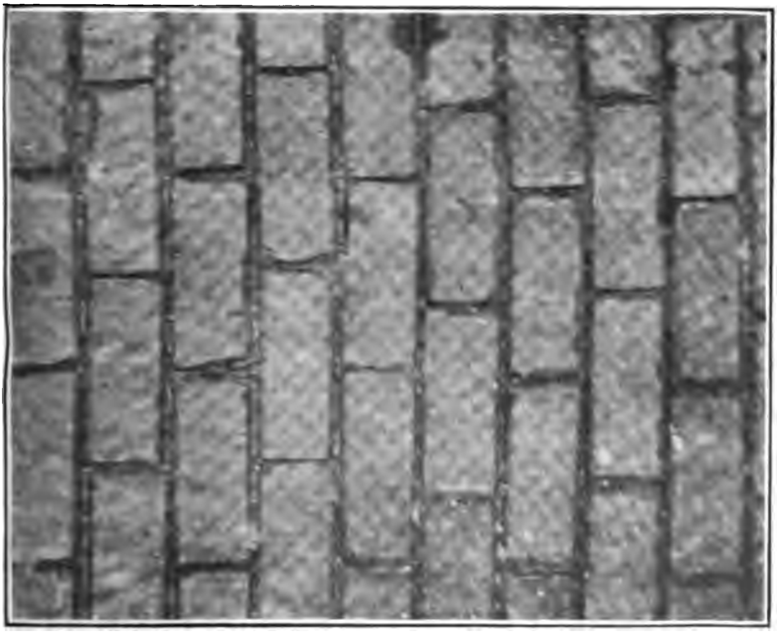


FIG. 9. SPALLED EDGES IN TAR FILLED PAVEMENT
Pavement one year old. Joints partially depleted of tar filler through flow of material.

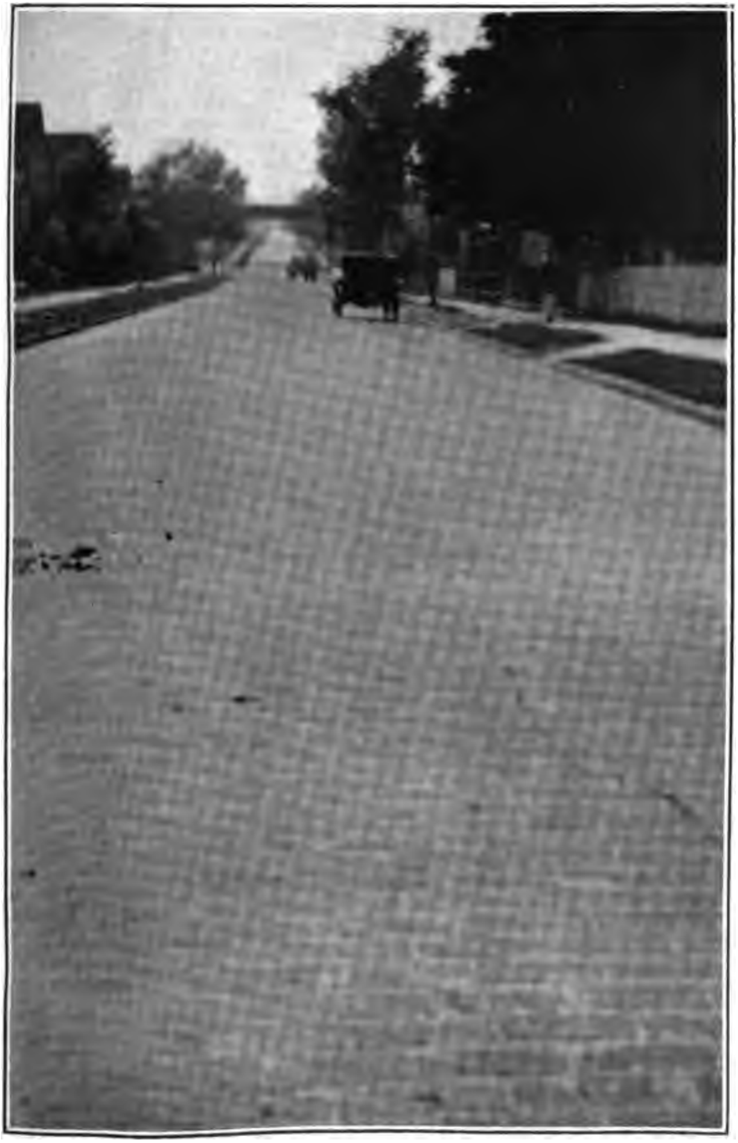


FIG. 8. LONGITUDINAL CRACK IN CEMENT FILLED PAVEMENT
Attributed to crown of pavement being raised by lateral compression.

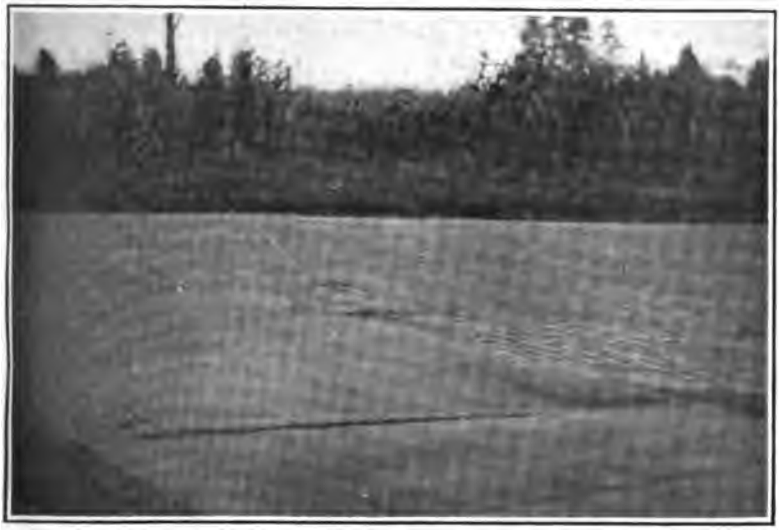


FIG. 10. CREEPING OF BRICK PAVEMENT, UPHEAVING RIDGE OF ASPHALT AT JUNCTION OF TWO PAVEMENTS AND TIPPING GAS MAIN COVER

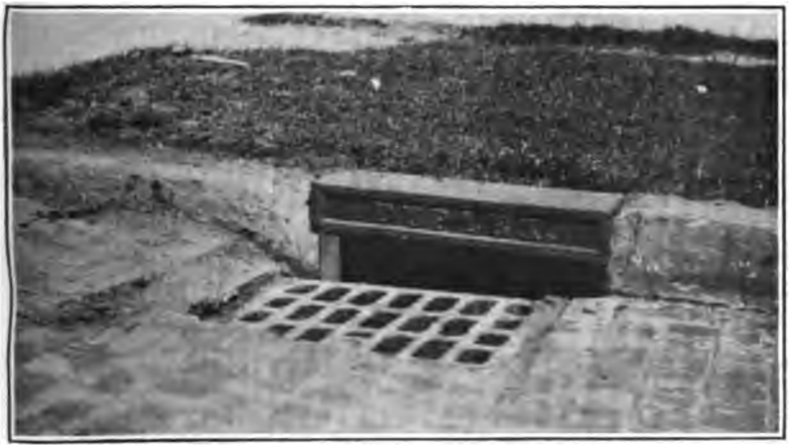


FIG. 11. CATCH BASIN GRATING SHEARED BY CREEPING OF PAVEMENT
Pavement has traveled about the width of one brick.

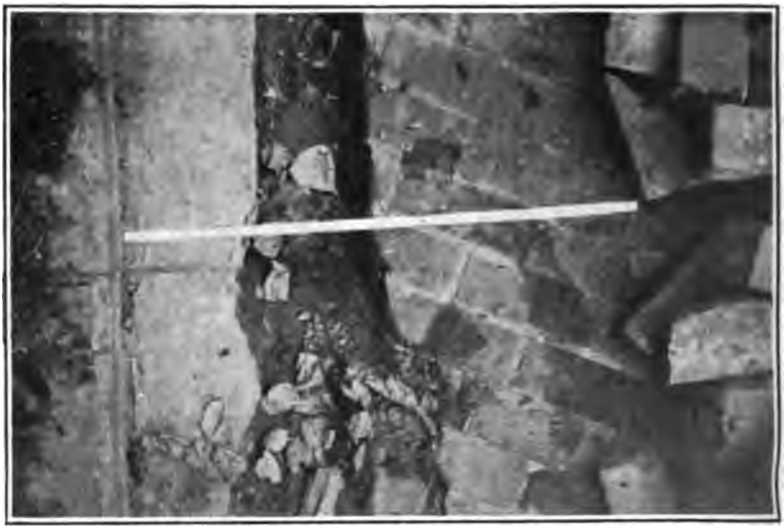


FIG. 12. CHANNEL BETWEEN PAVEMENT AND CEMENT GUTTER

Six inches wide. In part due to creep of pavement and in part to abrasive wear by wheels of vehicles.

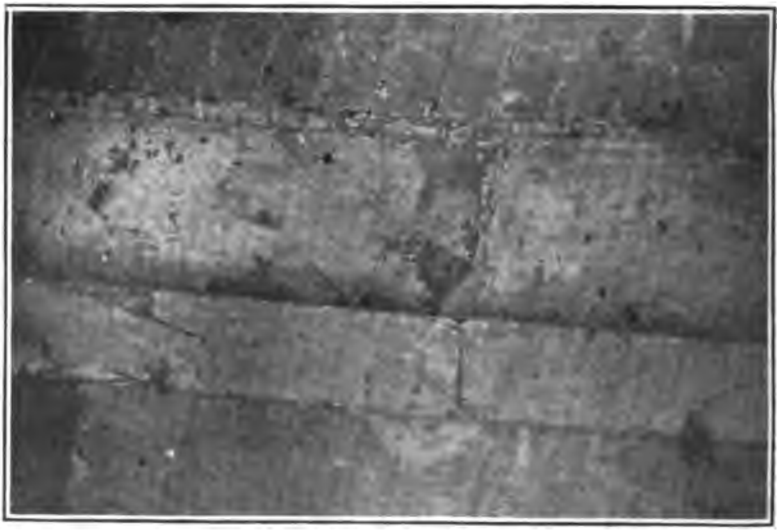


FIG. 13. CEMENT GUTTER FRACTURED FROM THRUST OF BRICK PAVEMENT

Outside edge of curve opposite place shown by figure 12.

One end of Belmore road abuts against Euclid avenue, on which there is a double track trolley line. The pavement of Euclid avenue offered little resistance against the creeping of this side street and facilitated the shearing of the catch basin grating.

These illustrations are selected as typical examples and it will not be necessary to refer to other similar instances. Having in mind the forces generated and their manner of development, it is generally an easy matter to consistently account for the effects of thermal conditions witnessed in pavements, and where unbalanced forces exist to predict those movements in the pavement which are realized.

There are places in pavements where very little changes in dimensions have occurred for a range of fifty or more degrees temperature. There is a compensation in the relief of initial longitudinal compression which occurs during a drop in temperature and this has nearly or quite compensated for the contraction incident to the lowering of the temperature. The result, observed at a section of Euclid avenue, near University Circle, Cleveland, was the maintenance of substantially a constant or fixed gauged length. Obviously, a section where no movement of the pavement occurs marks a place of great durability. Without the disturbing factor of changes of temperature the construction and maintenance intact of a monolithic pavement would be much simplified.

Measurements of transverse reference lengths are in general more regular and follow changes in temperature more consistently than the changes in the longitudinal reference lengths. It may be remarked in passing that no substantial difference appeared between pavements with and those without expansion joint at the curb, in respect to the display of lateral expansion and contraction. In a longitudinal direction the presence of occasional cracks across the roadway causes some reference lengths, those spanning the cracks, to be longer when the temperature is lowered by reason of the adjacent sections contracting and opening the joints. In few places is there strictly normal behavior witnessed in the longitudinal reference lengths.

Figures 12 and 13 show opposite sides of Carlyon road, East Cleveland, O., at the curve in the roadway near Superior avenue. At the time it was photographed, this part of the street was being repaired. At the inside of the curve, as shown by figure 12; the pavement had left the cement gutter and was forced over against the opposite gutter, shown by figure 13. The open channel between the pavement and the cement gutter at the inside of the bend was 6 inches wide. A considerable part of this opening, however, represented the result of abrasive wear of vehicles; it was not all due to the bodily movement of the pavement. From 2 inches to 2½ inches represents the maximum movement which has been observed in other streets taking place in a direction away from the inside curb.

The pavement of Carlyon road was under initial strains when the repairs were made. A portion of the pavement was torn up whereupon the part shown in figure 12 gradually moved outward radially, an additional distance of ¼ inch as first observed, which was subsequently found to have increased to about ½ inch. The pressure on the outer curb caused the fractures which are shown in figure 13. Sidewalk flagging afforded the necessary reaction to fracture the combined cement gutter and curbing.

In the case of Emily street, East Cleveland, which has a bend near one end of some fifty degrees, more or less, the pavement has left the inside curbing for a distance of 160 feet, crowding over against the outer curb. Tension cracks are on the outside of the bent pavement and where the longer tangent of the street has acted upon the shorter one. At the inside curb the maximum opening between the pavement and the curb was found to be 2⅛ inches.

The conditions in streets with short reversed curves are rather more severe than in single bends. The long tangents set up shearing stresses which fracture the pavement at the reversed curve. Figure 14 shows such an example on Cummington road, East Cleveland. The pavement was forced into close contact with the outside curbs of the bends, while at the inside curbs the openings were 1½ inches and 2 inches respectively. At the junction of Abington road with Cummington road, near the reversed curve of the photograph, there were two openings of 2½ inches each between the pavement and the curbstone. These several openings are believed to have been the result of the gradual lengthening of the pavements by alternate expansion and contraction. When it was cold, gritty material would sift into open cracks and prevent

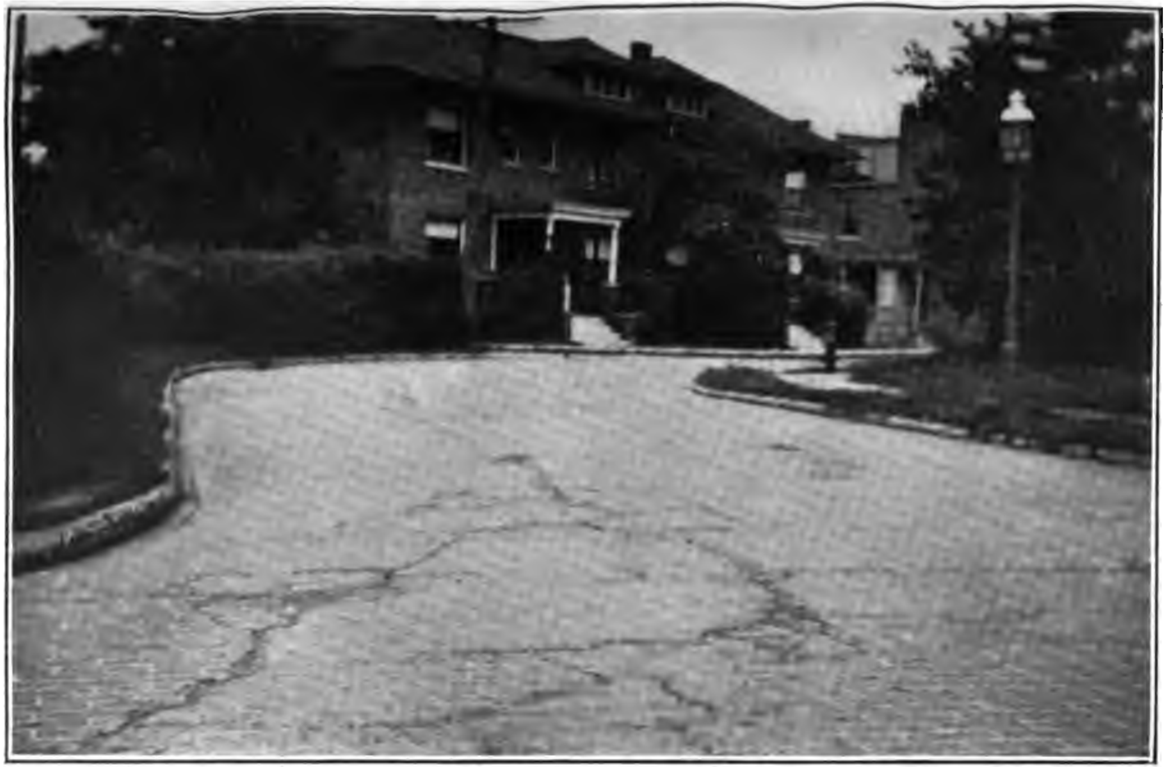


FIG. 14. SHEARING FRACTURES AT REVERSED CURVE IN ROADWAY

them closing subsequently when the pavement was next heated, this process being repeated, gradually causing a pronounced lengthening of the entire surface.

Some of the foregoing examples were taken from streets which have been paved for a term of years. The effects of changes in temperature are cumulative in part and it would require several years to elapse before certain effects reach a maximum stage of development. Predictions based upon the relations existing between the coefficients of expansion, the moduli of elasticity, and the crushing strengths of the bricks lead to the inference that when thermal effects are considered the behavior of these earlier paved streets may be taken as examples of what should eventually be found in current construction.

Greater strength may reside in recently constructed pavements but it may also follow that greater internal strains may be introduced by reason of the higher physical properties of the materials used. Internally generated forces depend for their magnitude upon the physical properties of the materials themselves. It is believed that thermal effects will be similarly displayed in pavements both of medium and of maximum strength, and either grade may be taken as indexical of the other.

Some additional illustrations are presented on features connected with the general subject of brick pavements.

Figure 15 shows a crack parallel to one of the rails of a trolley track, at University Circle, Cleveland. Cracks of this kind are caused by the depression of the trolley track carrying down the pavement which is bonded to or in contact with it. Only track of the highest degree of rigidity can safely be bonded to. It is injudicious to bring cement-filled brick pavements against the rails of trolley track generally speaking, and yet that may frequently be the most expedient course to adopt. It is not expected that all troubles will be eliminated even though the causes are well understood, and cracks must be looked for in certain places in monolithic pavements.

Transverse cracks in pavements are commonly the result of alternate changes in temperature, and some longitudinal cracks owe their origin to the same cause. Other longitudinal cracks are occasioned by the crosswise bending of the pavement. There are a number of causes which would occasion bending strains and which the rigid character of monolithic pavement would be unable to endure without fracture.

Figure 16 shows some longitudinal cracks between the rails and trolley tracks in West 14th street, Cleveland, O., which are attributed to the transverse or crosswise bending of these paved strips. The expansion of such narrow strips as these would be only a few hundredths of an inch for a range of 100° F. and compression forces due to changes in temperature would not account for the formation of these cracks. These cracks appear to be due to crosswise bending of the pavement, in reaching which result the depression of the tracks and possibly the yielding of the ties on which the track rests are important factors.

Figure 17 shows some tar bubbles coming out of the joints of a tar-filled pavement when exposed to summer heat. As is well known, a tar filler is softened and flows readily when under the influence of summer temperatures. It is quite prompt in flowing from the joints at the higher parts of the crown of the pavement, and collects along the edgestone.

Figure 18 shows a tar-filled pavement at the junction of Lamont avenue and East 97th street, Cleveland, O. This is a residential neighborhood and the streets in that vicinity are not exposed to heavy traffic. The pavement, however, presents a very rough surface due to the spalling of the edges of the bricks. It is certainly an unsatisfactory pavement in its present condition and illustrates the desirability of laying cement-filled brick pavements in residential streets where traffic is light, as well as in those streets where traffic is heavy.

Figure 19 shows the appearance of one of a number of single courses of creosoted wood blocks which were used in the pavements of East 32d street, Cleveland, O. These courses of wood blocks were introduced at intervals of about 150 feet each, and were evidently intended for the purpose of performing the functions of a transverse expansion joint. The bricks adjacent to the creosoted wood blocks were spalled in a number of places, as shown by the cut. The middle of the length of a straight street is believed to need no expansion joint; and as for the ends, they would be benefited by being confined by rigid marginal curbs rather than by the use of joints of a yielding character.

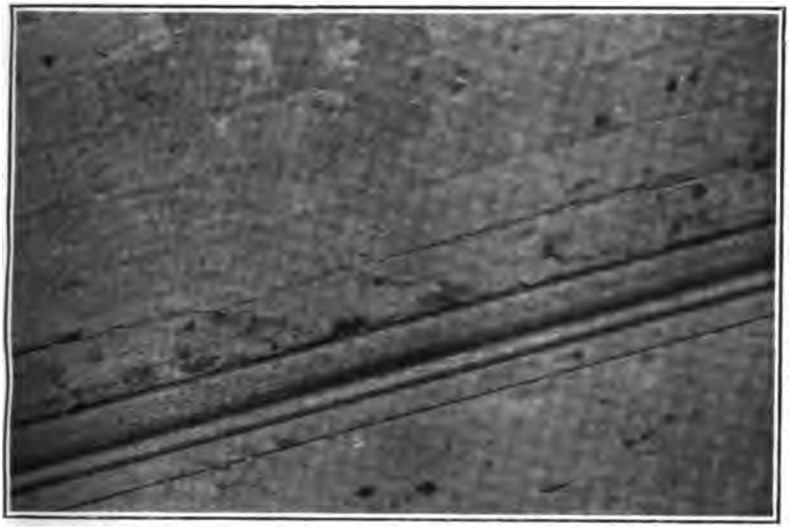


FIG. 15. CRACK IN PAVEMENT PARALLEL TO TROLLEY TRACK

Attributed to depression of track carrying down pavement.

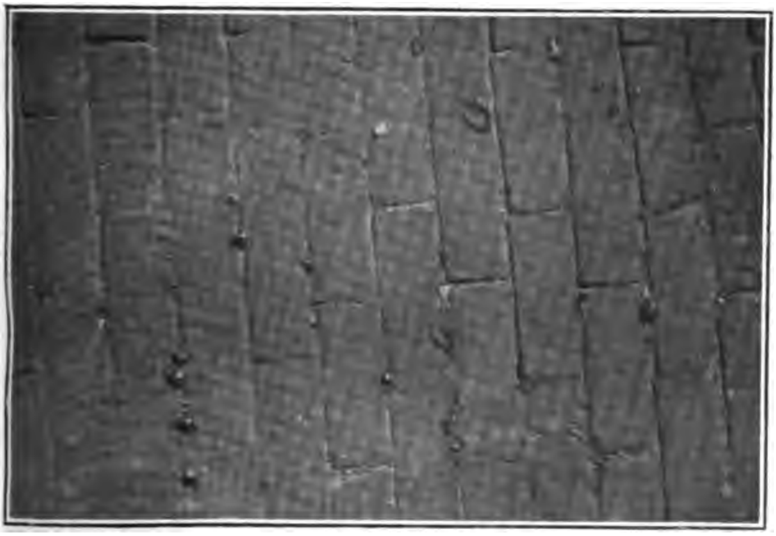


FIG. 17. TAR BUBBLES IN JOINTS OF TAR FILLED PAVEMENT

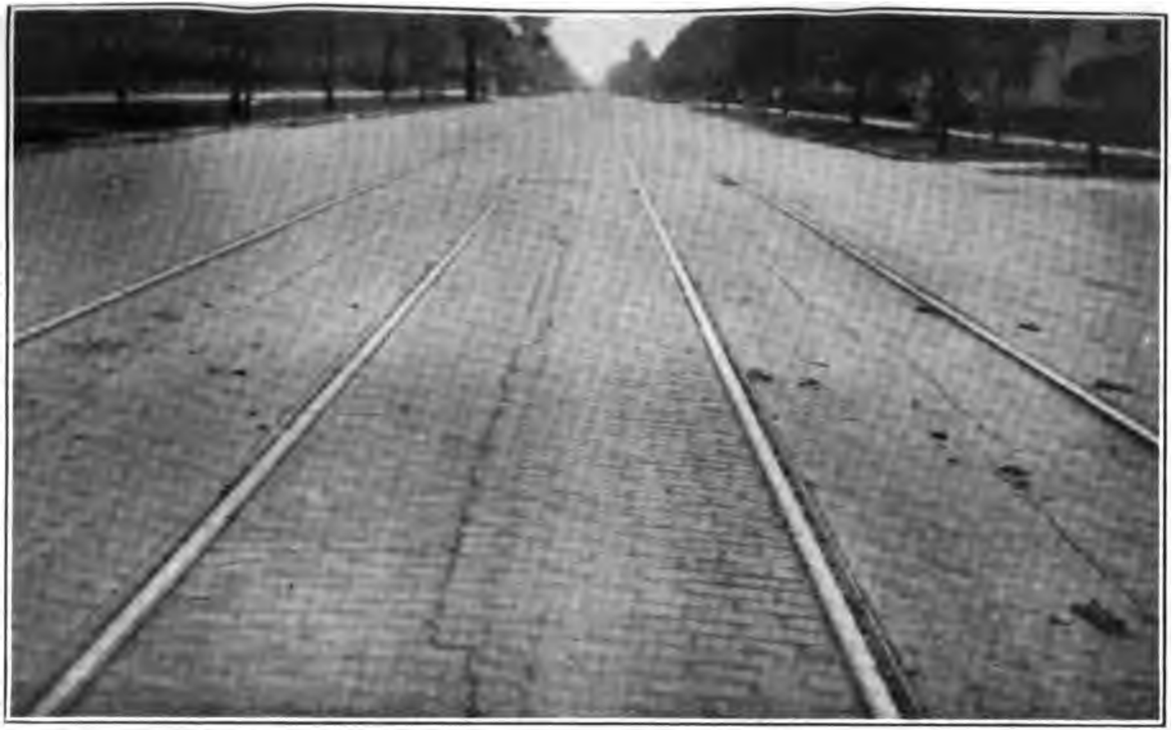


FIG. 16. LONGITUDINAL CRACKS BETWEEN RAILS AND TROLLEY TRACKS

Attributed to transverse bending of these paved strips.

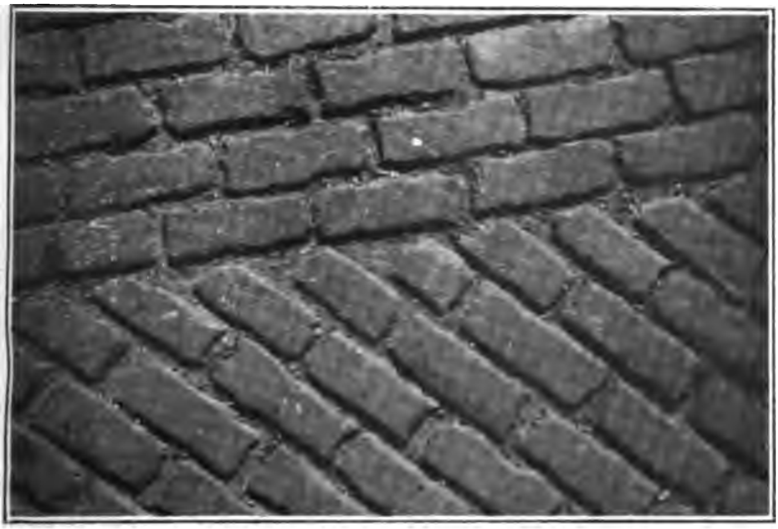


Fig. 18. Joints of Tar Filled Pavement Depleted by Flow of Tar from Crown of Street to Gutter

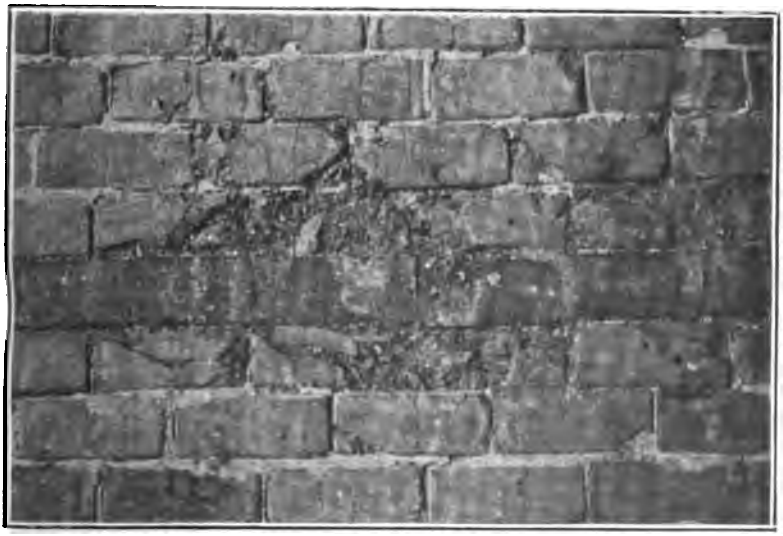


Fig. 19. Spalled Brick Adjacent to Course of Creosoted Wood Blocks

This being true, it is a mistaken idea to introduce transverse expansion joints in any part of a street. A pavement will be in a state of initial compression of magnitude only a portion of the year in northern climates. It has not yet been ascertained what state the pavements are in at winter temperatures. In general it would be expected that exposure to temperatures lower than that at which the cement-filler set would be attended by a state of tension in the pavement or an opening of the cracks between some of the courses. Nevertheless, the stresses induced by creeping might so modify conditions locally that some parts of the pavement would at least remain in a state of compression over a greater range of temperature than other parts.

The popular idea of the condition of a pavement is not infrequently based upon some feature entirely distinct from the pavement itself. Figure 20 shows the defective condition of the trolley track on Madison avenue, Cleveland, O. This street appears to have accquired an unenviable reputation for its pavement when in fact the pavement is very good, but owing to a particularly poor piece of trolley track the street can only be crossed with difficulty.

Figure 21 illustrates an upheaval of a sidewalk crossing on Ravine avenue, Cleveland, O. It is quite unlikely that such a detail will again be used, since the disrupturing effect of exposure to high summer temperatures on such a feature is well known. Longitudinal compressive forces are well resisted when the elements of the pavement parallel to its length are straight lines, but the introduction of sidewalk crossings sharply crowned, thus changing the elements to curved ones, makes very weak places, easily upheaved by rise of temperature.

Straight members, not curved ones, are employed in other engineering structures to sustain loads of compression and a street pavement is an engineering structure which is governed by the same laws as other structures which are similarly loaded. If there is a divergence in a pavement from the best form of compression member—that is, a flat surface—for drainage or other purposes, the departure should be a minimum.

In conclusion: It is believed that the integrity of cement-filled brick pavements can best be maintained by adopting such details of design and construction as will enable the pavements to resist forces of compression which are incident to alternate changes of temperature.

That provision to resist such compressive forces should apply to the pavement in both longitudinal and crosswise directions.

That initial compression, within limits, is a desirable feature to have in a pavement and that it seldom happens that the maximum compressive stresses occasioned by rise of temperature are sufficient to cause injury to the bricks by approach to their crushing strength.

That the middle parts of the lengths of straight streets are from position best located to maintain the continuity of the pavements intact.

That open ends of paved streets may be expected to display creeping tendencies and that such creeping will occur.

That end creeping is a consequence of a permanent lengthening of the pavement, and while individual bricks of the pavement will successfully resist compression stresses incident to rise of temperature, still the total force thus generated is too great to admit of being entirely resisted by marginal curbs or other means available.

That streets having others enter from one side only are unfavorably situated in respect to being exposed to overstraining forces.

That curved roadways have a tendency to leave the inside curbing and crowd against the outside.

That continuous pavements will not be expected to remain intact at short reversed curves in roadways, at least in the case of streets having long tangent ends.

That pavements, to successfully resist the compressive stresses caused by variations in temperature, should be laid as nearly flat as feasible, that is, with minimum permissible crowning.

That compression stresses in pavements in directions in which the elements are straight lines are advantageous rather than detrimental and assist in keeping the pavements intact. Conversely, that compression stresses acting in directions in which the elements are curved are menacing to the integrity of the pavements.

The compressive stresses referred to are those caused by thermal changes and which act in the plane of the pavement, and do not refer to loads or stresses normal to the surface of pavements, such as wheel pressures of loaded vehicles.

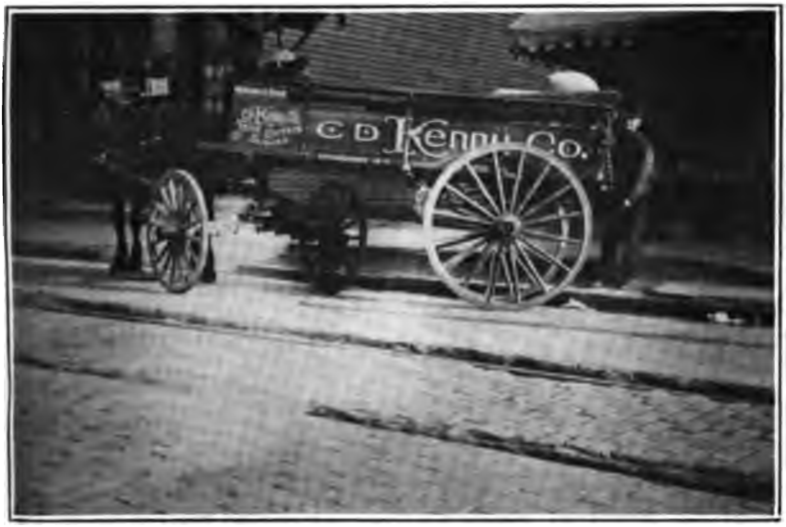


FIG. 20. DEFECTIVE CONDITION OF TROLLEY TRACK

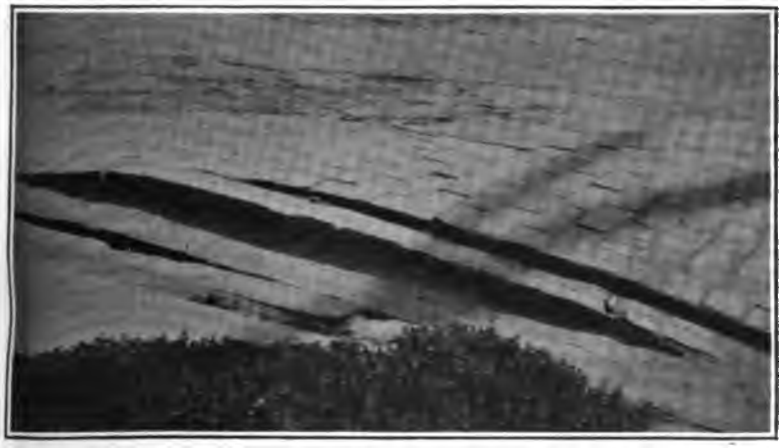


FIG. 21. UPHEAVAL AT SIDEWALK CROSSING

DISCUSSION

Mr. Craig: Have you made a study of the different materials used for expansion joints—asphalt or pitch, and the consistency of them?

Mr. Howard: We have made no observations yet on that subject. All of those fillers are so soft that the brick will crowd them out at the side. I believe the difference in consistency of the fillers would be practically insignificant, compared with the force of the brick.

THE DURABILITY OF GROUTED GRANITE PAVEMENTS

By WILLIAM A. HOWELL, *Engineer of Streets and Highways, Newark, N. J.*

At the Erie convention of 1910 the writer presented a paper on "Close Jointed, Cement-Grouted Granite Pavements," in which the work incident to the introduction of that form of pavement in the city of Newark was described in detail. The object of the writer in presenting this paper is to review the history of grouted granite in Newark and other cities during the past three years, and to ascertain if this form of pavement continues to give the satisfactory results, under heavy traffic conditions, claimed for it by its friends and advocates.

Up to November 1, 1912, the city of Newark had laid under public contracts 12.54 miles of grouted granite, having an area of 235,825 square yards, laid at a cost, including cost of inspection and advertising, of $922,214. Contracts awarded during the present year but remaining uncompleted on account of labor troubles, call for 1.43 miles additional, carrying a yardage of 29,900 square yards, at an estimated cost of $114,539. In addition to the above, there has been paved privately 0.17 of a mile of this form of pavement during the past three years, at an estimated cost of $11,000. Newark, therefore, has laid or has under contract 14.15 miles, or 269,000 square yards, of grouted granite of the latest approved specifications, laid at a cost of $1,050,000. In Newark we have 16,240 square yards, or about 0.8 of a mile, laid at least three years, and 77,100 square yards additional, or about 3⅘ miles of pavement, down at least two years.

Of the 12.54 miles laid under public contract, we have 3.96 miles from Long Cove, Me.; 0.38 of a mile from Rockport, Mass.; 0.25 of a mile from Vermont; 5.72 miles from New Hampshire; 0.75 of a mile from Mt. Airy, N. C.; and 1.46 miles from Salisbury, N. C.

It would seem, therefore, that we have at hand plenty of reliable data from which to draw conclusions as to the practical utility of grouted granite. It is not the intention of the writer to enter into detail, describing the efforts of the engineering department of our city in their endeavor to secure blocks properly made at the quarries, capable of meeting the rigid specifications at first introduced three years ago. It was his effort to cover this matter carefully in the previous paper. Realizing as does the writer the importance of a rigid adherence to the standard specifications, in order to secure the necessary uniformity in sizes of blocks and of minimum width of joints, the fact remains that the essentially important part of the work of producing a satisfactory grouted granite pavement must be given by the engineer to the production of the grout mixture, its preparation and its application to the blocks.

The first granites tried out in Newark under the revised specifications of 1909 were from Long Cove, Maine, and from Rockport, Mass. These granites are very hard and not particularly susceptible to cement grout. We managed with infinite care to grout successfully a number of streets paved with the Long Cove granite, we succeeded in grouting two streets paved with the Rockport granite, but we had a number of almost total failures where one or the other granite was used. The writer on September 6 and 7 visited a section of New England where grouted granite has been in successful use for several years. The portion of New England visited was within a radius of 35 miles from Milford, N. H., and took in the cities of Lawrence and Lowell, Mass., and Manchester and Concord, N. H. The quarries visited were located as follows: (1) West Chelmsford, Mass., owned by Mr. Fletcher; (2) Kittredge Quarry at Milford, N. H.; (3) Lovejoy Quarry at Milford, N. H.; (4) Tonella Quarry at Milford, N. H.; (5) Swenson Quarry at Concord, N. H.; (6) New England Quarry at Concord, N. H.; and (7) The Bailey Quarry at Suncrook, N. H.

It is not our purpose in this paper to describe the methods of operating these quarries, but in passing it gives us pleasure to state that after visiting at least twenty New England granite quarries, the writer never saw such thoughtful provision made for the comfort and welfare of the block makers as was done at the Kittredge Quarry at Milford, N. H.

The streets inspected during our trip were as follows:

Lowell, Mass.

Middlesex Street. Three-quarters of a mile long. Pavement laid three years, street railway tracks the entire length of the street, track pavement also grouted. Heavy traffic. A portion of this street has been laid four years. The grouting is in excellent condition.

Central Street. Part of the pavement has been laid six years and a portion five years. In good condition.

Merrimac Street. Two street railway tracks, pavement about one-half of a mile long, laid three years, in first class condition. Traffic heavy.

Bridge Street. Down two years, 45-foot roadway, street railway tracks. Looks good.

Graham Street on a steep grade. Street railway tracks.

In Lowell they intend paving five streets this year. The usual practice is to pave a portion of a street at a time and pave the remaining portion another year. On the work in Lowell, Chelmsford granite is used principally.

In Lowell, Lawrence, Lynn and Everett, the municipality buys the blocks and the paving work is done by the street commissioner's force.

Lawrence, Mass.

Essex Street. Paved in 1909 with 4-inch blocks. This street is 100 feet wide and the roadway about 80, and has two street railway tracks. The material used was Milford granite principally, with some Concord granite. This street was paved by the Hassam Paving Company and was very heavily grouted on top of the blocks.

Lawrence Street. One block laid by the street commissioner one year ago.

Broadway. One and one-fourth miles long, paved three years ago. The material used was 4-inch Chelmsford block. The work was done by a local contractor and the grouting is not wearing well. There are many bare spots in the middle of the job.

Common Street. Laid 1908. This pavement is about three-quarters of a mile long and was done by a local contractor. There are many holes and depressions in the pavement. This street is the same length as Essex Street. The roadway is 40 feet between curbs. There is no concrete base, 7-inch blocks being used on a rolled base.

South Broadway. This street is being paved this year with 7-inch blocks not on a concrete base.

Manchester, N. H.

Elm Street. This is the principal street of the city, 70 feet between curbs, two car tracks. The paved portion of the street is about one mile long. The grouted granite work has been laid eight or nine years. The traffic is moderately heavy, but fairly well distributed.

On this trip the writer endeavored to get some data from the granite quarry men as to the reasons why certain granites are more susceptible to cement grout than others. Of the three principal constituents of granite—quartz, feldspar and mica—the granites having an excess of quartz or feldspar are to a marked degree less susceptible to cement grout than granites containing a larger proportion of mica. In other words, mica is the only component part of the granite block having an affinity for the grout. The union between the granite block and the cement grout is not a chemical union, but purely mechanical. The grout sinks into the cavities and cracks in the granite and is tied in, or anchored in, by the little sharp bead like projections of mica, which penetrate the soft grout layer on top of the block and in the interstices between the blocks, and after the hardening of the grout finally become firmly fixed and embedded in the solidified mass.

SPECIFICATIONS

Our Newark specifications for grouted granite, which are identical with the specifications adopted by the Association for Standardizing Paving Specifications, are as follows:

Cement grouting

After the pavement has been brought to a uniform surface, Portland cement grout shall be poured into the joints until it appears on the surface. The grout shall be broomed into the joints, if necessary to fill the same, and the operation must be continued as the grout settles until the joints are thoroughly filled flush with the surface of the blocks, immediately after which the entire pavement shall be broomed to smooth surface, sufficient grout being applied to bring said surface even with the highest part of any of the blocks. The blocks shall be wet by sprinkling immediately before applying the grout, if the condition of the atmosphere requires this precaution to be taken.

Composition of cement grout

The cement grout shall be composed of one or more measures of the best quality of freshly burned Portland cement to not to exceed one measure of clean sharp sand. The mixture to be employed for any piece of work shall depend upon the hardness of the granite used; and the mixture shall be ascertained by sufficient experiments to give a grade which will be of such a strength as to wear down uniformly with the granite used. In the mixing of the cement and sand, clear water shall be used to give the proper consistency.

The grout must be mixed for this purpose in a box resting on legs of different lengths, so that the mixture will readily flow to one corner of the box, the bottom of which shall be 6 inches above the pavement. The mixture must be removed from the box to the street surface with scoop shovels, all the while being stirred in the box as the same is being emptied; one such box to be provided for each 10 feet of width of roadway. The work of filling should thus be carried forward in line until an advance of 15 to 20 yards has been laid, when the same force and appliances shall be used to regrout the same space in a like manner, excepting that the proportion of the mixture shall be two parts Portland cement to one part sand. To avoid the possibility of causing the grout to become too thick at any point, there should be a man with a sprinkling can, the head perforated with small holes, slightly sprinkling the surface ahead of the sweepers. To insure the penetration of the grout into the joints of the pavement there shall be used, in addition to the brooms, a squeegee scraper 15 to 18 inches in length, on the last application of the grout.

Within one-half to three-quarters of an hour after the last coat has been applied and the grout between the joints has fully subsided, and when the initial set is taking place, the whole surface must be slightly sprinkled and all surplus mixture left on the top swept into the joints, bringing them up flush and full. After the grouting is done and a sufficient time for hardening has elapsed, so that the coating of sand will not absorb any moisture from the cement mixture, one-half inch of sand shall be spread over the whole surface, and in case the work is subjected to a hot summer's sun, an occasional sprinkling sufficient to dampen the sand should be followed for two or three days.

After the grouting is completed, the streets shall be kept closed and no carting or traffic allowed until at least seven days have elapsed on any portion of the street grouted, and the face of the pavement shall be kept moist if the condition of the weather requires this precaution. The contractor shall erect sufficient and well constructed barricades and furnish watchmen at all times if the same shall be necessary, to insure that this precaution in regard to the prevention of traffic or carting is complied with. Should the bond between the blocks become broken for any reason, the joints at such places shall be cleaned out, even if it is necessary to take up and relay the blocks, and such parts so taken up and relaid shall be regrouted and re-barricaded.

The attention of the writer having been called to the difficulty experienced in securing good results in the grouting of a certain important highway, and also to criticism by drivers of teams and other heavy loaded vehicles drawn by horse power, as to the slipperiness of grouted granite, the writer has given careful study to the subject and has arrived at the following conclusions: The contract for the paving of the public highway referred to was originally awarded to a contractor of large experience, but had been several times sublet, until the actual work of paving and grouting had been given to a man whose sole aim was to complete as large a yardage of pavement as he possibly could every working day. The sub-contractor referred to took no interest whatever in getting good grouting, what interested him was completing his work as rapidly as possible and getting his money. The cement was known to be good, New Hampshire granite was used, and yet most of the grouting disappeared within a very short time. The concrete base was exceedingly rough, and the sand bed under the blocks varied greatly in thickness, in some places not running over one-half inch. The blocks were not properly rammed, and the grout mixture was not prepared in a box, but was mixed right on top of the pavement, and gravel was used instead of sand.

In the city of Newark we have not had a single failure where New Hampshire granite was used and where the grouting was completed before November 15. We have had excellent results on a number of streets where granites other than the New Hampshire granite were used. There is no question as to the durability of the grouting where soft granite is used and where the specifications are rigidly adhered to. We have several miles of grouted granite in Newark where the granite has successfully stood the most severe test of heavy traffic for several years. We have inspected many miles of this form of pavement in Troy, N. Y., Worcester, Mass., and other cities.

As to the criticism of slipperiness. There are certain seasons of the year when all pavements are more or less slippery. During the Indian Summer, for instance, when the air is full of mist, a thin film of moisture will fasten itself on the pavement, and if the blocks are not frequently cleaned the whole surface will become greasy and slippery. The same effect is caused by the action of frost. If the pavement is perfectly clean the granite will not be as slippery when affected by frost as when it has a thin coating of dirt or grease. An instance referred to in the previous paper has occurred to the writer. In the city of Troy there is an important highway carrying two street railway tracks, the entire width, both tracks and roadway outside, being paved with grouted granite. There are quite a number of intersecting streets paved with asphalt or brick. The highway referred to is on a moderately steep grade, 6 per cent I believe, and carries much heavy traffic. During the winter previous to our inspection not a single horse fell on the grouted granite. A few horses slipped on the rails and fell, but the horses who kept away from the rails secured a firm foothold from the grit in the cement. On the cross streets paved with asphalt and other smooth pavements, horses were falling constantly all through the winter. Ogden street, Newark, was paved with grouted granite about one year ago. The space between the curbs and the street railway tracks is not over 11 feet. The old pavement taken up was macadam, and had been in a bad state of repair for several years. This street is located in a lumber yard and brick yard district, and the traffic is heavy. The granite used on this piece of work was from Mount Airy, N. C. The street grades were under 2 per cent. A prominent merchant owning a large number of teams, who used this street constantly, informed the writer that he had never seen or heard of a horse falling since the completion of the new pavement. The gentleman referred to volunteered the information that with the advent of the new pavement the traffic had increased 100 per cent. On Cross and Division streets, two hill streets in this district, where the grades are about 7 per cent and where the traffic comes from the Lackawanna freight yards in addition to the heavy traffic from Ogden street, no complaints have ever been received that the grouted granite was slippery. These two streets are paved with New Hampshire granite, and the grouting was done three years ago and is still very good. On Bloomfield avenue part of the street is on a 5 per cent grade, and west of Mt. Prospect avenue the grades seldom exceed 1 per cent. Business men located on this street and teamsters using the pavement were questioned, with the following results: When the street is not perfectly clean, and at the same time is wet, horses will slip on the steep portion of the street, particularly so at the intersections with cross streets, where the pavement is covered with a thin coating of mud or slime. When the pavement is perfectly clean and a shower falls on the grouted work, horses find no trouble in securing a foothold. Testimony favorable to the non-slipperiness of grouted granite was also received from property owners and teamsters on Alyea street, avenues A and B, Hedden street, Wright street, Main street, Christie street, Freeman street, Academy street, South street, Tyler street, Chestnut street, Thomas street, Murray street, Prospect street, Gouverneur street and Watson avenue. The city engineer of Worcester, Mass, writes:

> Replying to your inquiry of October 9 relative to complaints of slipperiness of grouted granite, I do not recall complaints of any nature specifying the grouted granite as put down here. The fire department have little or no difficulty in moving apparatus over it all seasons of the year with speed, and the pavement is preferred over any other that we have ever tried by teamsters and others using horses. I attribute much of our success in the use of granite blocks to the fact that we have always used the New Hampshire granite, the greater part of the blocks coming from the Marlboro quarries, which is soft enough to wear without polish, and hence for a slight degree of slipperiness. We have been accustomed to pave between our tracks with the same material, and in the same manner in the business sections of the city. We have now 17.5 miles of grouted granite blocks, and intend, where there is any amount of travel, to lay this kind of pavement.
>
> FRED A. McCLURE.

The city of Newark, with the coöperation of the county of Essex, has completed the paving of two very important highways known as county roads, Bloomfield avenue and Frelinghuysen avenue.

Bloomfield Avenue figures.

	Feet
Bloomfield Avenue, Newark, Contract No 1 completed....	6,596
Bloomfield Avenue, Newark, Contract No. 2 completed....	2,185
Bloomfield Avenue, Montclair, under construction.........	8,310
Bloomfield Avenue, Bloomfield, will be taken up 1912......	9,010
Bloomfield Avenue, Glen Ridge, will be taken up 1912.....	3,980
Bloomfield Avenue, Belleville, no action taken yet.........	700
	30,781

Work completed or under way, 17,091 feet.

Bloomfield avenue starts at Belleville avenue, Newark, and extends through the municipalities of Belleville, Bloomfield, Glen Ridge and Montclair. The entire length of the street to the Verona line is about six miles. Of this length 8781 feet, or 1.66 miles, have been paved under contracts in the city of Newark. One contract calling for 2185 lineal feet was completed one year ago, and contract No. 1 calling for 6596 lineal feet was completed two years ago. On both contracts New Hampshire granite was used. The grouting is wearing exceedingly well and standing the heavy traffic finely. The grouting is standing very well immedi-

Grouted granite streets of Newark

Name of street	From	To	Kind of granite	Length in feet	Square yards		Final estimate	Date of final estimate	Remarks
Arlington St......	Market St.	Court St.	Long Cove	1,643	4,025	$307	$15,032.46	Nov. 28, 1909	
Augusta St........	Plane St.	Shipman St.	Long Cove	465	638	307	2,837.26	Sept. 27, 1909	
Cross St..........	Spring St.	Ogden St.	N. Hampshire	268	823	314	3,103.11	Dec. 27, 1909	
Christie St........	Passaic St.	Ferry St.	Rockport	1,100	4,304	307	15,362.37	Mar. 28, 1910	
Division St.......	Spring St.	Ogden St.	N. Hampshire	215	733	315	2,703.33	Dec. 27, 1909	
Fifteenth Ave.....	South 10th St.	South 19th St.	L. C. & N. H.	2,182	9,168	309	32,415.87	July 25, 1910	
Main St...........	Ferry St.	Kossuth St.	Long Cove	1,652	6,477	307	22,506.27	May 30, 1910	
Prospect St.......	Market St.	Ferry St.	Chester	522	1,715	300	6,103.91	Nov. 28, 1909	
Orange Pl.........	Orange St.	High St.	Rockport	290	697	307	2,735.85	May 30, 1910	
Division Pl........	Park St.	Centre St.	Long Cove	600	1,046	320	4,323.64	May 30, 1910	
Thomas St.........	Mulberry St.	Dawson St.	Long Cove Rockport	1,270	5,038	307	17,490.64	July 25, 1910	
South Canal St....	Mulberry St.	River St.	Vermont	1,341	2,764	301	9,758.94	Sept. 26, 1910	
Rose St...........	Bergen St.	Kipp St.	Long Cove	880	2,867	334	10,840.18	Oct. 31, 1910	
Watson Ave.......	Elizabeth Ave.	Jeliff Ave.	N. Hampshire	1,420	5,751	340	20,945.98	Oct. 31, 1910	
Hackett St........	Plane St.	Westerly	N. Hampshire	245	656	361	2,855.99	Oct. 31, 1910	
Murray St........	Nurr Ave.	Ave C	Long Cove	1,656	6,626	317	23,718.64	Nov. 28, 1910	
Commercial St....	Railroad Pl.	Easterly	N. Hampshire	600	1,594	351	7,282.35	Nov. 28, 1910	
Garrabrant Pl.....	Bridge St.	Northerly	N. Hampshire	231	293	349	1,585.96	Dec. 12, 1910	
Bloomfield Ave....	Mt. Prospect	City Line	N. Hampshire	6,596	17,621	309	66,337.12	Dec. 12, 1910	
Jackson St........	Bridge Approach		Long Cove	277	1,462	296	4,203.09	Sept. 26, 1910	
Frelinghuysen Av.	Miller St.	Dayton St.	Salisbury, N.C.	7,715	35,704	309	131,333.77	July 1, 1911	
Alyea St..........	Ferry St.	Hensler St.	Mt. Airy, N.C.	800	3,096	311	10,891.25	July 31, 1911	
Ave A.............	Emmet St.	Ponier St.	Mt. Airy, N.C.	768	5,087	300	17,345.00	Aug. 28, 1911	
Ave B.............	Emmet St.	Miller St.	Mt. Airy, N.C.	480	2,471	309	8,757.10	July 1, 1911	
Bloomfield Ave....	Mt. Prospect	Belleville	N. Hampshire	2,185	5,712	301	22,307.26	Dec. 4, 1911	
Chestnut St.......	Pacific St.	Elm Road	Long Cove	3,500	11,245	329	43,240.90	July 1, 1911	
Exchange Al......	Hay Alley	Mechanic St.	Long Cove	175	190	330	715.90	July 1, 1911	
Gouverneur St....	Mt. Pleasant	Passaic St.	Long Cove	476	1,734	312	6,369.78	July 1, 1911	

Hay Alley.........	Alling St.	Ward St.	Long Cove	236	259	330	964.10	July 1, 1911	
Hedden Place.....	Orange St.	City Line	N. Hampshire	326	1,478	325	5,647.83	May 29, 1911	
Kirk Alley.........	Lawrence St.	Ward St.	Long Cove	317	560	330	2,196.20	July 1, 1911	
Plum Pt. Lane....	Hawkins St.	Manfr's R. R.	N. Hampshire	1,108	2,990	309	10,811.86	Sept. 25, 1911	
Ogden St...........	Clay St.	Bridge St.	Mt.Airy,N.C.	1,882	4,577	305	18,097.31	Dec. 30, 1911	
Van Buren St.....	South St.	Clifford St.	N. Hampshire	230	903	305	3,114.24	Dec. 30, 1911	
Delancy St.........	Pacific St.	WheelerPt.Rd.	Long Cove	3,300	13,619	307	43,742.58	May 27, 1912	Started in 1911
South St...........	Pacific St.	Van Buren St.	N. Hampshire	1,800	8,708	299	28,763.39	May 27, 1912	Started in 1911
Warren St.........	Plane St.	Newark St.	Long Cove	2,563	9,430	302	33,799.38	Sept. 30, 1912	Started in 1911
Academy St.......	Plane St.	High St.	Long Cove	746	1,879	312	7,145.71	Sept. 30, 1912	
Frelinghuysen Av.	Dayton St.	City Line	N. Hampshire	5,213	25,282	297	88,940.52	Aug. 31, 1912	
West Kinney St...	Washington St.	High St.	Long Cove	810	1,780	314	6,969.20	Oct. 31, 1912	Estimated
Tichenor's Lane..	Murray St.	Parkhurst St.	N. Hampshire	555	1,479	297	5,100.00	Oct. 31, 1912	Estimated
McWhorter St.....	Elm Chestnut	Vesey-Johnson	N. Hampshire	1,700	5,500	309	18,937.00	Nov. 31, 1912	Estimated
Wright St.........	Broad St.	Ave B	N. Hampshire	1,440	5,874	307	20,868.79	Aug. 31, 1912	Estimated
Market St.........	Railroad Pl.	Bowery	N. Hampshire	4,500	11,070	301	45,000.00	Dec. 31, 1912	Estimated
				66,278	235,925		$853,202.03		

Work awarded but not completed

Christie St........	Ferry St.	BonykamperAv.	N. Hampshire	925	3,700	$330	$13,542.00		Estimated
Bonykamper Av..	Hawkins St.	Christie St.	Long Cove	652	2,900	309	9,823.50		Estimated
Tyler St...........	Walnut St.	Chestnut St.	N. Hampshire	1,575	5,700	313	20,131.00		Estimated
Adams St.........	Chestnut St.	South St.	N. Hampshire	900	3,600	314	12,764.00		Estimated
Cabinet St........	Norfolk St.	Camden St.	Long Cove	1,375	5,500	309	19,615.00		Estimated
Dickerson St......	Norfolk St.	First Ave.	Long Cove	1,500	6,000	309	21,070.00		Estimated
Runyon St........	Seymour Ave.	Osborne Ter.	N. Hampshire	625	2,500	309	9,109.00		Estimated
				7,552	29,900		$106,054.50		

ately adjoining the street railway tracks, showing that it is possible to get good results even where the car headway during the rush hours is not over two minutes, and about five minutes during the rest of the day. The roadway between the curbs is 39 feet and the space between curbs and rails is about 12 feet. A census of the traffic taken from 9.30 a.m. to 11.30 a.m. showed the passage of 1.5 vehicles per minute, and the period taken was one of the least busy portions of the day. The town of Montclair has awarded a contract, which is partly completed, calling for the paving of 8310 feet of this street, or 1.57 miles. The work is well under way and would have been completed by this time if the street railway tracks had been put to the new grade and paved. Labor troubles, however, have delayed the latter work very materially. New Hampshire granite is being used on this work. The distance from the curbs to the rails of the street railway tracks is 17.5 feet. Essex County, N. J., in connection with Hudson County, is paving the plank road between the Passaic and Hackensack rivers with grouted granite. New Hampshire granite is also being used on this improvement.

The city of Newark, in coöperation with the county of Essex, has completed the paving of Frelinghuysen avenue from Miller Street, Newark, to the Union County line, a distance of nearly 13,000 feet. The city of Elizabeth is paving the rest of the street. The distance between curbs in Newark is 60 feet, with two street railway tracks, the roadway between rail and curbs being about 22.5 feet. In the city of Elizabeth the roadway is much narrower. The Newark paving has been done under two different contracts. One contract, started in 1910 and completed in 1911, called for the paving of 7715 lineal feet of street; the second contract, completed on September 1 of the present year, called for the paving of 5213 lineal feet of street. The work in the city of Elizabeth is 5600 feet long. This will give a grouted granite roadway of 18,528 lineal feet, of which 10,813 feet was laid or will be laid with New Hampshire granite, and 7715 feet with Salisbury granite from North Carolina.

TEN ESSENTIALS FOR SECURING GOOD CEMENT GROUTED PAVEMENT

1. Be sure your sub-grade is well rolled, and all soft places eliminated. The concrete should not be too rough and should be laid to a true crown; a uniform thickness of 2 inches of sand bed under the blocks should be maintained.
2. The blocks, after careful culling, should be well rammed.
3. Be absolutely sure the cement is good and the sand is clean and sharp; a small percentage of loam, not over 5 per cent is allowable.
4. Great precautions should be taken to have the correct proportions of sand and cement in the mixture.
5. Keep the mixture continually agitated in the box. Always remove the grout mixture from the box with scoop shovels. The contents of the box should never be dumped on the street; wherever this is done there is always a bare spot in the grouting.
6. The blocks should be thoroughly wet by sprinkling immediately before grouting.
7. Grouting should not be attempted during cold or frosty weather; good results are seldom secured after November 15 in the latitude of New York City.
8. If the grouting is done during very hot weather, it should be immediately covered with an one half-inch coating of sand, which should be kept constantly moist by frequent sprinkling during the continuation of the hot spell.
9. Traffic should be kept away from the grouted pavement for at least seven days.
10. If the best results are desired with a minimum amount of effort, the use of a moderately soft granite, similar to New Hampshire granite, is recommended.

DISCUSSION

Mr. Parkes: In reference to the pavement laid in Massachusetts by The Hassam Company, you said it was heavily grouted on top of the block. Do I understand there was a mortar coat on top of the granite block?

Mr. Howell: Yes.

Mr. Parkes: To what extent?

Mr. Howell: Half an inch.

Mr. Parkes: What do you call heavy?

Mr. Howell: Anything over a quarter of an inch.

Mr. Parkes: Does it approximate a mortar coat?

Mr. Howell: Very close to it; it was at least half an inch; it may have been more.

Mr. Blair: The practice as stated in that paper was followed in the construction of a Medina stone pavement on the Square in Cleveland in 1901. The only difference was that in Cleveland there was as little left on top of the stone as possible, but the joints were thoroughly filled. That is probably the heaviest traffic street in Cleveland. It is smooth, and I have never known a horse to slip or an automobile to skid on that pavement.

TESTING PAVEMENTS IN DETROIT

By J. C. McCABE, *Boiler Inspector*

Periodically during the past twenty years sharp controversies have arisen in Detroit as to the desirability of using various types of paving and the quality of material therein. The most recent agitation occurred about eighteen months ago. The mayor demanded that all paving brick be subjected to the standard rattler test, and no pavers be used testing over 20 per cent. It appears that the mayor was advised that with low rattler loss, the pavers would be correspondingly more desirable and give better street wear.

It had been the custom of the department of public works for years to make rattler tests at a local foundry for the purpose of getting a line on the material submitted, although no condition as to abrasion loss entered the purchase agreement—the agreement being to replace defective pavers found in pavement after a period of three years.

Early in 1911 a standard rattler was installed at the Eastern stone yard and many tests made from all shipments of brick for Detroit streets, although the per cent loss was not fixed. Much criticism of the department was made because of the purchase of "rotten" brick which failed in the streets, the character of failure being in some instances a complete shattering of the brick, but in the greatest number of cases the incipient wearing of ruts by the excessive wear of one or more bricks here and there in the pavement.

Criticism was made of a section of Grand River avenue near Humboldt avenue, where the brick showed a tendency to fail but a standard rattler test gave a loss of 16.15 per cent. This pavement was laid in 1907 and the traffic is not heavy.

In order to get a line on the behavior of brick under known traffic, both as to number of loads and weight of loads, tire width, etc., the speaker located an ideal place for this observation in the private alley of the Willis avenue Edison power plant on Willis avenue just west of Woodward avenue. Twelve loads of coal were hauled into this alley daily for eight months of the year, the gross weight being about 19,000 pounds and the tire width being about 4 inches. This gives about 1185 pounds per inch width of tire. Willis avenue leading to the alley was paved with Trinidad asphalt in 1904 and in 1906 the alley was paved with brick on concrete and sand cushion and grouted with 1:1 sand and cement. The coal was unloaded midway in the alley. The brick failed completely under this traffic from wheel abrasion, and has since been repaired. The asphalt shows no ruts nor apparent damage. The upper end of the alley in question, paved when the damaged portion was laid, is still in excellent condition. A rattler test made from the original brick taken from the side of alley gave a loss of 10.44 per cent.

The observations made during 1911 led Commissioner Haarer to send the speaker to the plants in Ohio and Michigan to make tests at the plants and observe methods of manufacture.

It is not our purpose to appear unduly critical, but inasmuch as the Detroit department of public works was severely criticised as being solely responsible for the apparent lack of service given by paving brick in Detroit, a simple statement of facts found will no doubt be of benefit to all parties concerned.

In the rattler observations it was noted that periodically one or more of the brick tested showed considerable loss in spots, which really received mild impact in the rattler, and it was the speaker's desire, if possible, to find the reason why.

The per cent loss being calculated from the ten bricks put in the test, it generally escapes notice and comment if one or two bricks have heavy loss, if the result on the ten comes within the limit fixed. It occurred to the speaker that this indication found in the rattler was the primary cause of the ruts or pockets found in brick pavements. With this belief a visit was made to many plants and it was found that the majority of manufacturers were using material from number five and six formations without taking proper care to mix materials uniformly. Samples of material were taken from the pug mills at intervals and analysis showed a variation of about 8 per cent in oxide of silica and 6 per cent in oxide of aluminum, also in the alkalies. These facts give a reasonable solution of the lack of uniformity of the brick shown by the rattler.

In one instance this year a paver which has given excellent service in Detroit developed in a few shipments pronounced lack of uniformity of material under the rattler tests and under the direction of Commissioner Haarer a visit to the plant in question disclosed a stratum of material about 10 inches thick of the following composition:

	Per Cent
Silica	48.53
Alumina	26.40
Iron oxide	6.08
Calcium oxide	0.31
Magnesium oxide	0.21
Potassium oxide	1.90
Sodium oxide	2.74
Volatile at red heat	14.25

An analysis of the main body of clay gave:

	Per Cent
Silica	57.42
Alumina	27.20
Iron oxide	2.76
Calcium oxide	0.25
Magnesium oxide	0.21
Potassium oxide	1.00
Sodium oxide	1.16
Volatile at red heat	9.88

Two samples were made from each of these materials and heated to the point of vitreous fusion with the result that the first material reached 2815 and 2806° F., and the second samples reached 2784 and 2756° F. The make up of the first sample would indicate that it would fuse first, but an examination after removal from the electric furnace showed the first sample more porous and lighter than the second sample.

The foregoing is mentioned in order to indicate that the brick manufacturers can with profit follow the methods of cement manufacturers.

Careful inquiry was made into the coefficient of expansion of brick used in Detroit and developed that it ran from 0.000002 per cent to 0.000006 per cent, temperature range 50° to 500°.

The fact that the brick that gave the lowest loss in the rattler did not consistently show best wear in the streets led Commissioner Haarer to instruct the speaker to design a method of testing that would reproduce all the conditions, as near as possible, met with in street traffic. To do this it was necessary to construct a pavement in the same manner as laid in the streets, use wheels loaded to any desired amount per inch width of tire and use the horse-shoes. It was evident that the real test would consist in moving a load repeatedly over the pavement, the load and velocity to be under the control of the operator. It was further desired that the means employed give an opportunity to study the behavior of several kinds of paving in one test.

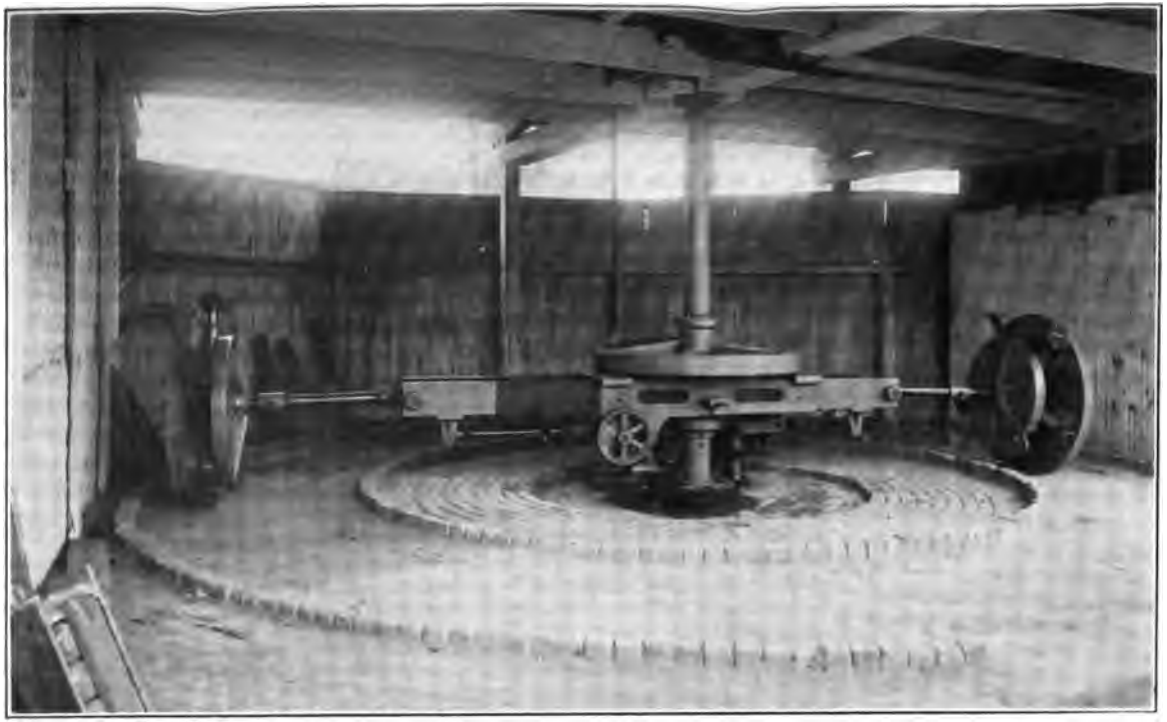
The machine is made to revolve about a vertical shaft which carries, on a bearing, a head which forms a bearing for a steel frame, at each end of which are jointed T-castings. These T-castings carry the shafts upon which solid cast iron wheels are mounted. The shaft also carries the cam plate which actuates the horse-shoes. The wheels are moved across the pavement by a train of gears shown below steel frame. The measurement from outside to outside of wheels is 19 feet 8 inches. The greatest wheel radius is 10 feet 10 inches, and the least radius of travel of inside edge of wheel is 8 feet 7 inches. It requires 333 revolutions about the circle to move the wheels across the pavement 2 feet, which is the limit of travel. Several inches of pavement is left outside of the wheel path to observe whether or not the sand cushion would flow under the constant traffic.

The test shown in pictures was made at 9 revolutions per minute about the circle, which gave a travel of 6.96 miles per hour, while the wheel speed when traveling on the inner circle was 5.51 miles per hour. The desirability of uniform speed was considered, but it was deemed more desirable to provide for the variable speed in order to study the effect of this difference on the actual wear.

The foundation of the pavement consists of 8 inches of concrete. The paving is laid on 2 inches of sand which is packed by a hand pounder until it was firm and uniform. The concrete sample is 6 inches thick and laid on the foundation.

All samples of brick paving were carefully grouted in with a mixture of 2 sand to 1 of cement.

The cedar block is laid on sand and filled between in the usual manner with gravel. This paving stood for sixty days before the test was made. High speed was used to observe and find the limit



General View of Pavement Determinator

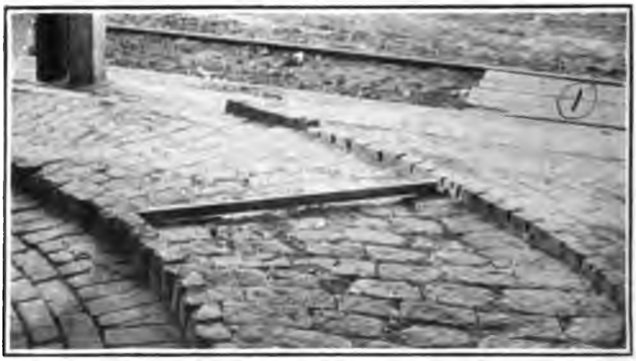


Fig. 1. Granite Pavement after Test

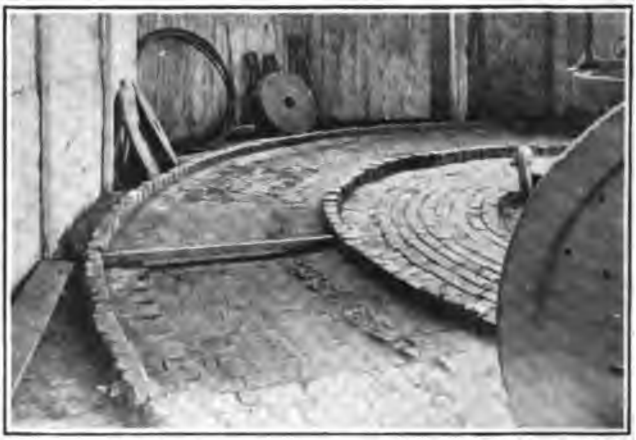


Fig. 2. Creosote Block after Test

of speed for the samples as well as the behavior of the sand cushion. The granite (No. 1) was first to show distress, as it soon loosened up in the grouting under the impact of the wheels. The creosote (No. 2) next to the granite shows the effect of the movement of the wheel over the rough surface of the granite, as it has been forced down more on the side near the granite. The brick (No. 3) next to the creosote block rattles 21 per cent on an average, but shows considerable chipping and wear. The cedar block (No. 4) is badly compressed and forced into the sand. The brick (No. 5), following cedar block, is completely destroyed, largely due to failure of cedar block, which induced the rut in this brick, which usually rattles about 22 per cent. The next brick (No. 6) is badly ground up, but not wholly from failure of the preceding sample, as it will be noticed in the picture on the inner part of the circle that the failure was not started by the previous sample. The next sample is concrete (No. 7) laid by the Wayne County road commissioners' specifications. The first few inches was destroyed by shock due to failure of last sample. The last sample (No. 8) was a brick which tests in the rattler about 27 per cent. It will be noticed that this brick shows uniform wear, except at the outer circle, where it is broken from a start given by a slight failure of the concrete.

In the design of the machine in question, which we call a "paving determinator" as the most suitable name to designate its intended purpose, provision is made for the use of any type of wheel. In the first tests a solid cast iron wheel was used, in order that no part of the shock or impact would be absorbed. A defect under one wheel does not communicate shock to the other.

The determinator is expected to show the following:

1. The comparative durability of various kinds of paving materials.
2. The best manner to lay paving to obtain best results.
3. Means to compare actual wear of brick paving against the rattler method.
4. The best method for cushioning of pavements.
5. The safe limit of load and speed for paving.
6. The proper mixtures for concrete roads.

The foregoing may look like a rather large job, but I wish to say that the Universal Portland Cement Company has arranged for the use of the machine for the purpose of securing accurate data on concretes under wheel abrasion.

Commissioner Haarer is endeavoring to solve the paving troubles for Detroit. One peculiar fact remains, and that is that under the guarantee system, streets paved with brick of relative high rattler loss have had comparatively few repairs. In Detroit we are inclined to doubt the general belief that a low abrasion loss as indicated in the rattler insures a lasting pavement, even when construction in both cases is above criticism.

It will be noticed in the pictures that the sand has shifted from under the wheel load, forcing up the material inside and outside of the wheel path—the greatest amount at the outside, due to higher velocity and greater wheel impact.

The behavior of the sand cushion lead us to investigate its characteristics under frost. The sample shown in plate No. 9 is river sand. The cast iron box is 8⅞ x 7½ inches x 2½ inches deep; the cubical content being 166.4 cubic inches. This box was filled with sand and packed firmly and struck off, leaving the pan flush full. This sand absorbed 51.5 cubic inches of water, which weighed 29.75 ounces. The sample was then frozen in a temperature about 2° below zero. It will be seen from the plate No. 11 that the dilation occurs at the center of the box. By measurement the volume had increased 4 cubic inches. By calculation the increased volume should have been 5⅓ cubic inches —4⅓ for the water and about 1 inch for shrinkage in volume of the pan under low temperature. The sand after freezing was dry at the surface owing to freezing in a dry atmosphere.

This no doubt accounts for longitudinal cracks between car tracks and curbs and near the center of streets with no car tracks, at times. It seems that the restraint of curb and car tracks forces the dilation to about midway. Plate No. 14 shows a brick pavement broken in this manner. It is well to remember that brick and concrete are due for shrinkage while the frozen sand is expanding.

Plate No. 11 shows the same sand as in plate No. 9 after drying out for three days after the freezing test. This sand was placed on the testing machine and a load of 53,240 pounds put on the sand area of 66.55 square inches, or a load of 800 pounds per square inch. The compression was 0.0625 inches, or 2½ per cent of volume.

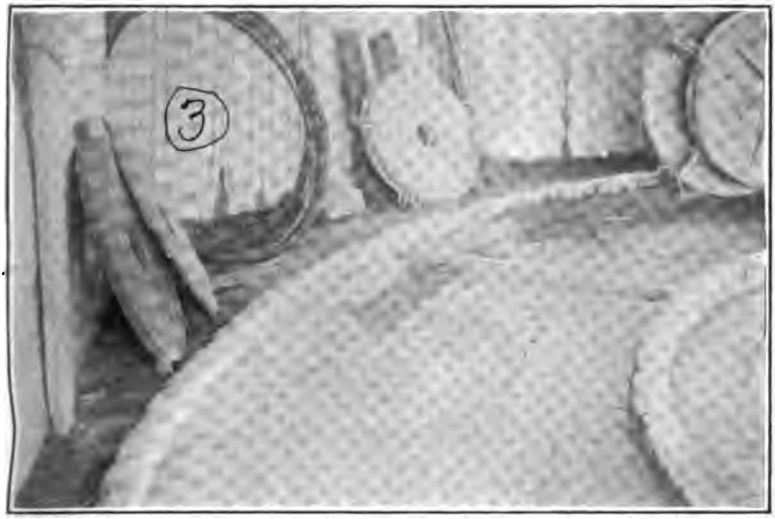


FIG 3. METROPOLITAN BRICK AFTER TEST

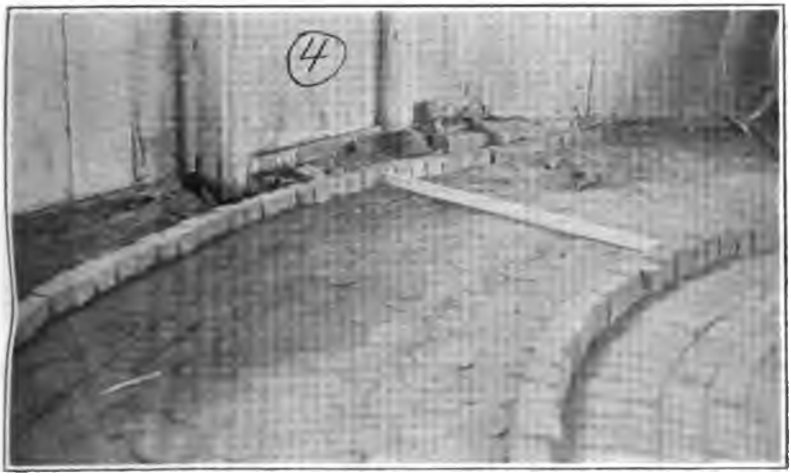


FIG. 4. CEDAR BLOCK AFTER TEST

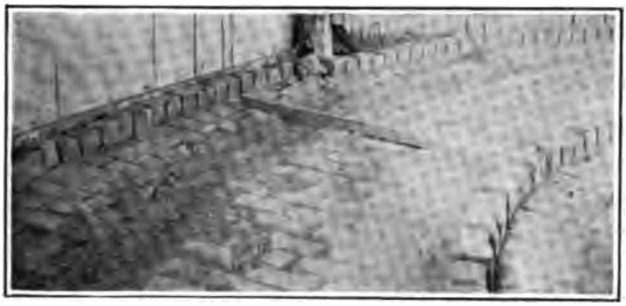


Fig. 5. Townsend Brick after Test

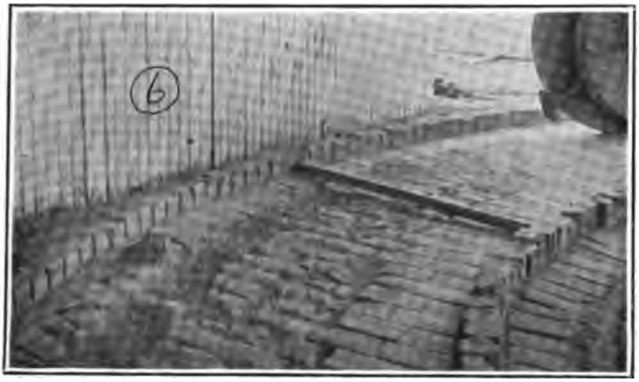


Fig. 6. Medal Brick after Test

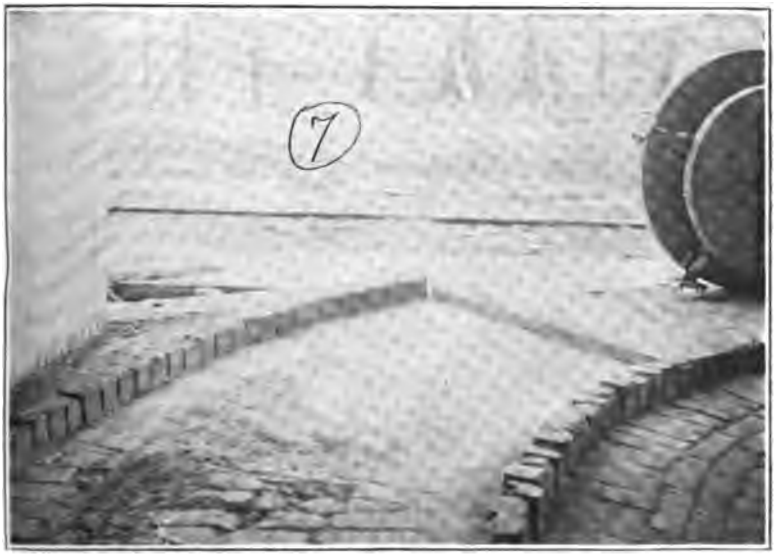


Fig. 7. Concrete Pavement after Test

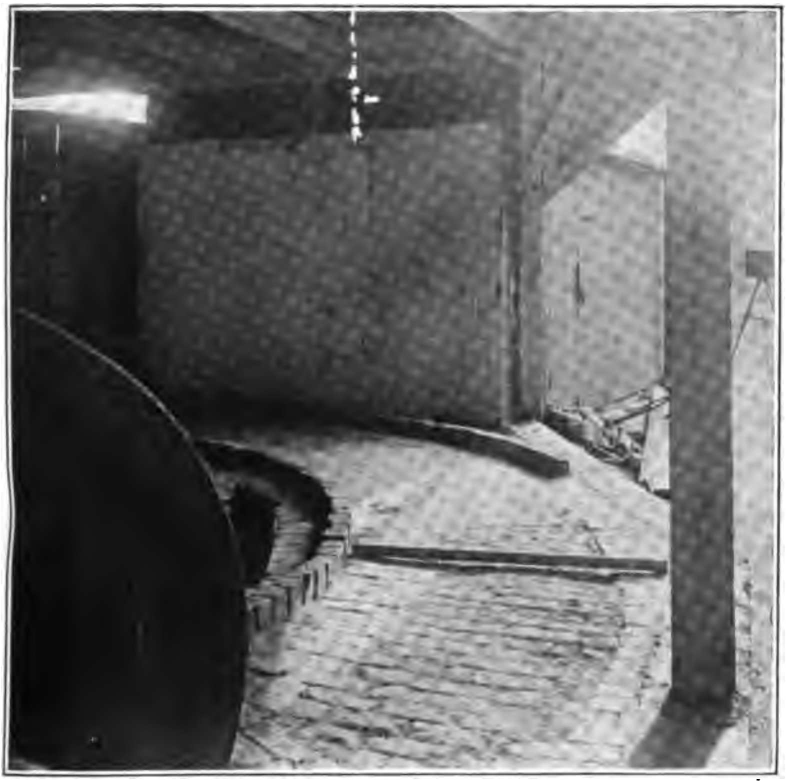


Fig. 8. Champion Brick after Test

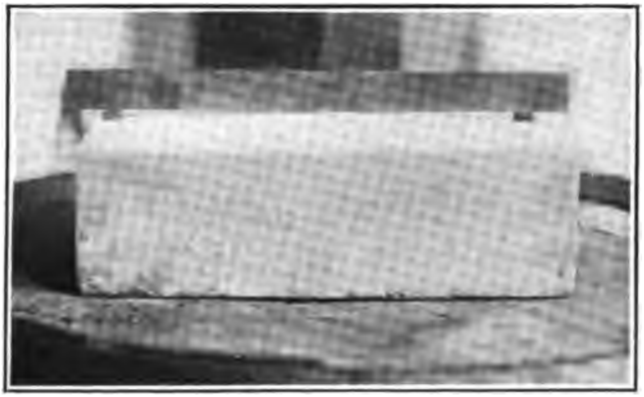


Fig. 9. Frozen Sand in Iron Box

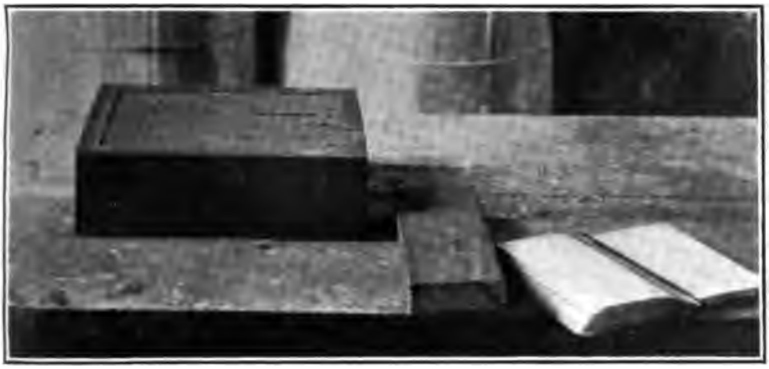


Fig. 10. After Drying for Three Days after Freezing

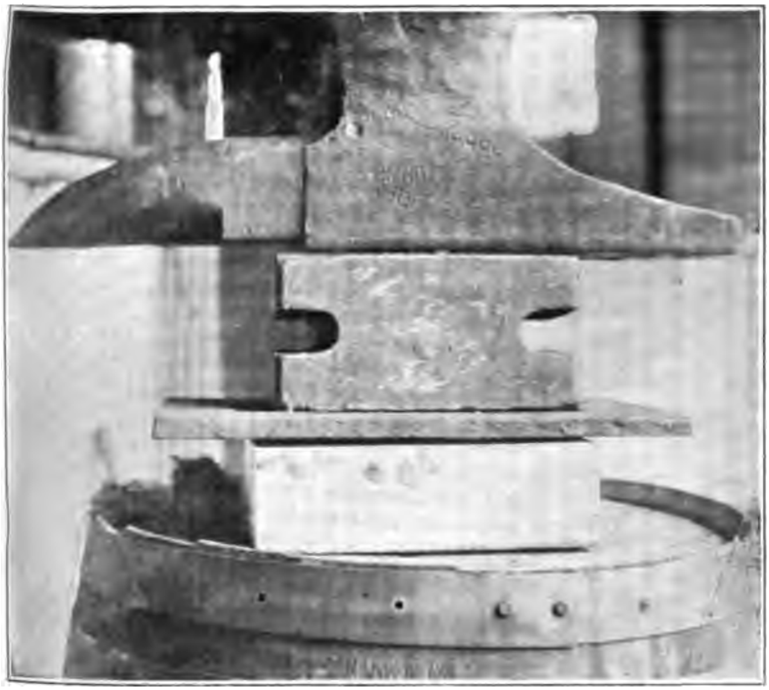
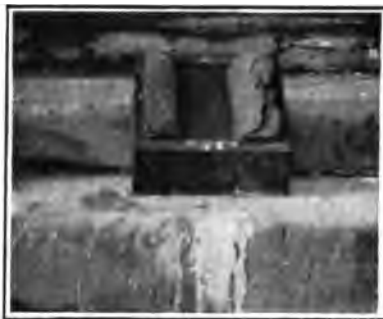


Fig. 11. Compressing Sand in Iron Box



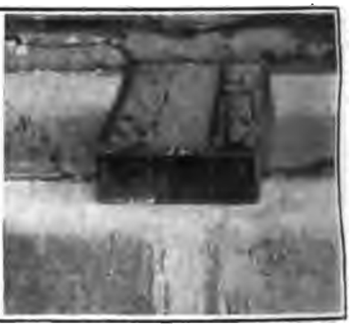


Fig. 12. Sand after Compression

Fig. 13. After Shock

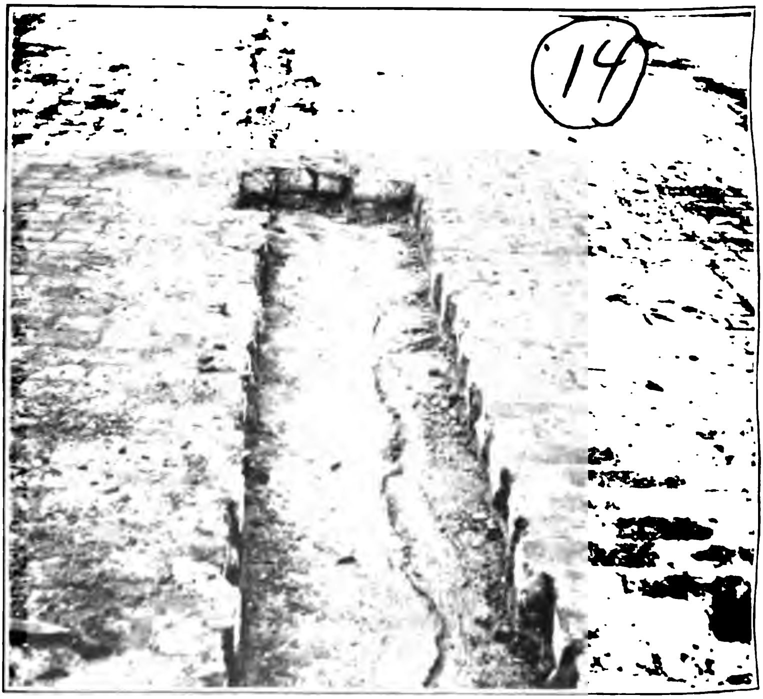


Fig. 14. Crack in Foundation Probably Due to Freezing Subsoil

Plate No. 12 shows view of sand after test with load placed in center of sand. This test was made after test shown in plate No. 11, wherein a uniform load of 800 pounds per square inch was put on the sand. A strip with 30.625 square inches surface was used to take the load. At 4600 pounds, or 105 pounds per square inch, the sand flowed perceptibly. At 11,000 pounds, or 362.4 pounds per square inch, the strips sank into the sand to a depth of ⅛ inch. At 14,500 pounds, or about 473 pounds per square inch, the strips had been forced to a depth of ¼ inch. At this point the sand column broke and flowed over the box as shown in the plates.

Plate No. 13 shows the effect of sand after shock from five blows of a weight of 6 pounds dropped five times through a space of five feet. It will be seen that the displacement is about the same as found in plate No. 12, when load was increased uniformly.

It would appear from the foregoing that the life of a brick pavement is greatly dependent on the thoroughness of the grouting and the distribution of the load on the sand.

With a load of say 5000 pounds per wheel, which may be concentrated on a single brick, and which would be about 145 pounds per square inch on the average paver, the sand would be of material support to the pavement, as the load is well inside the point where flow begins even without surface restraint. However, the element of shock changes the complexion of the problem, as the sand appears very unstable under shock.

Plate No. 14 is a view of pavement on Clinton Street near Rivard. The foundation is excellent concrete, cushion 1¼ inch sand. The bricks are well grouted. The width of the crack in foundation averages ½ inch and is in about the center of the street, although at another point on this street there are two cracks on each side of center of street. The subsoil is largely sand and holds over 20 per cent water by volume. The volumetric dilation of subsoil under this pavement was great.

Plates No. 15 and No. 16 are taken from rattled brick and are the same brand shown in plate No. 17. It will be seen that the pavement shown in this plate is excellent, except for the rut started from four brick which are not uniform material.

Plate No. 18 shows the asphalt and brick pavement mentioned, over which coal is hauled to the Willis Avenue Edison Plant. The brick shown was renewed last year, the former brick being destroyed from wheel abrasion.

The first test made by the "paving determinator" indicates to us that failure was started in the brick samples that were the hardest. A reason for this may lie in the inability of the hard brick to hold the grout as well as the softer brick.

The brick shown in plate No. 8, a 27 per cent one by the rattler, did not flow the sand cushion within 50 per cent of the other brick. The following figures give the depression of sand in the several samples of paving tested. Granite, ¾ inch; Creosote Block, ¾ inch; Metropolitan, 1¼ inch; Cedar, 1¼ inch; Townsend, 1¼ inch; Medal, 1 inch; and Champion, ½ inch.

It would appear that the problem presented in the construction of a brick pavement is that we are to construct a simple beam built up with one member of concrete, which should be considered as being in tension, while the member which carries the load direct would appear to be in compression. Between these two members we have a shifting, unstable material (sand). It might be worth while to consider the construction of a foundation reinforced laterally and built up to take the brick surface at the curb in restraint. Temperature measurements indicate that internal stress from temperature change would not destroy either member.

The work to date in Detroit has been more to find a proper starting point. It is the intention of Commissioner Haarer to continue his investigation of paving materials along strictly practical lines, with the object of obtaining from first class materials unexcelled pavements for the city of Detroit.

Detroit hopes to have some interesting experimental data to submit to this organization within the next year.

DISCUSSION

Mr. Blair: Almost every principle shown in that experiment was tried out and discredited about thirty-five years ago. Such men as Professor Ogden and some other eminent scientists and students discredited all of those suggestions. The last effort along the line of testing materials of this character was undertaken about four years ago, and a report of that has already been incorporated in your proceedings. A more careful report has been submitted to the American Society for Testing Materials. A reprint of that can be obtained if anyone cares to go into that question.

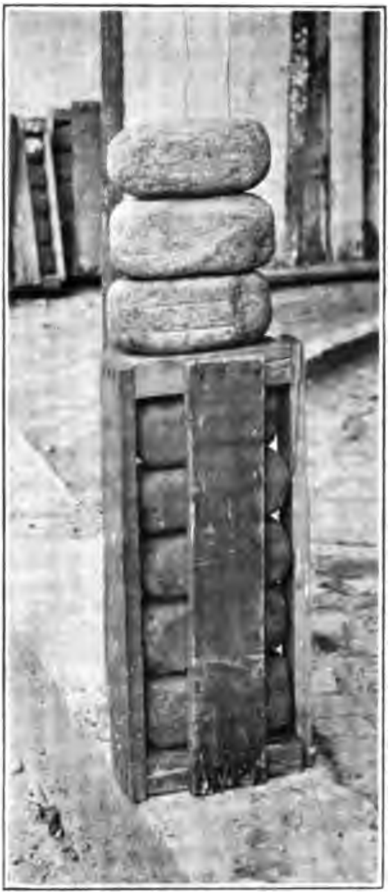


Fig. 15. Rattled Brick

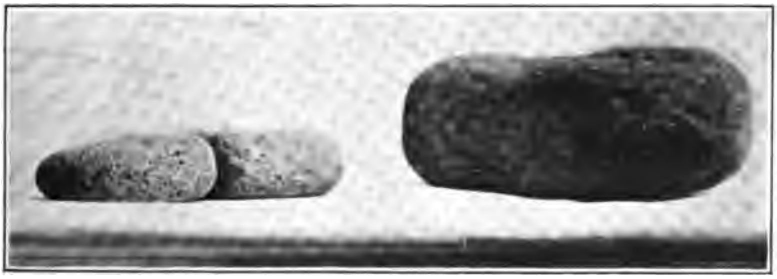


Fig. 16. Rattled Brick, Same Make as Shown in Figures 15 and 17

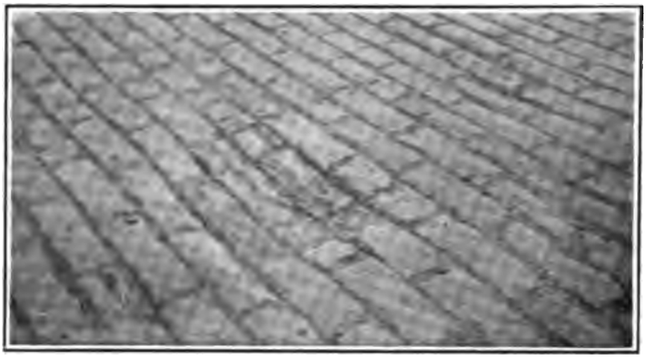


FIG. 17. HOLE STARTED FROM SOFT BRICK

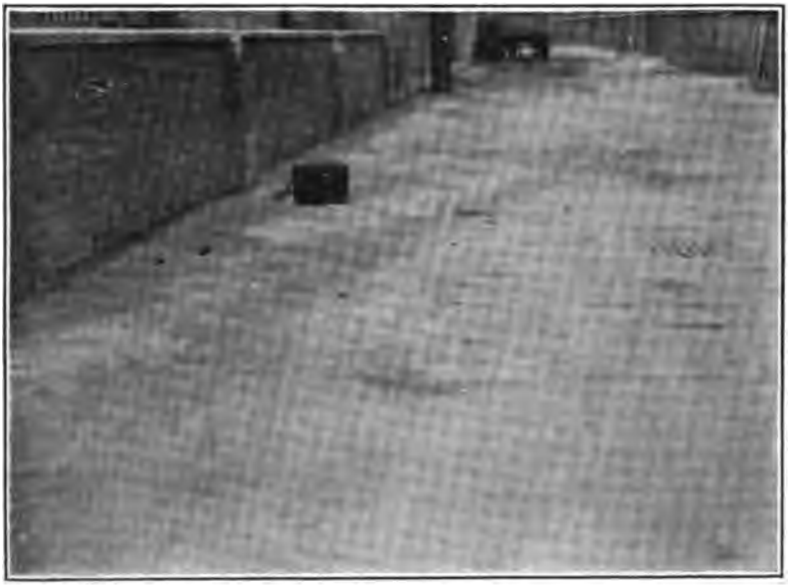


FIG. 18. ASPHALT AND BRICK DRIVEWAY AT WILLIS AVENUE EDISON PLANT

THE FALLACY OF THE INDISCRIMINATE USE OF CONCRETE IN CONSTRUCTION

By SIDNEY G. GEORGE, C.E., *Assistant Professor of Civil Engineering, Cornell University*

So much has been made of the many undisputed advantages of Portland cement concrete as a structural material, so many are the examples of its use in various common and peculiar constructions, so appalling in scope and in minute modifications of mixture, reinforcement and placing, has our information become, so enormous in the bulk of the literature detailing its constituents, tests and applications in construction, and yet so common in examples before our very eyes or recorded in current periodicals are the instances of the injudicious choice of concrete for certain purposes or in certain applications, that a few points deserve careful consideration in order that the proper place of concrete among the materials useful in engineering works may be plainly apparent. The merits of concrete should be, usually are, clearly in mind, but with these, one by one, separate and distinct, must be recorded those specific disadvantages, those lacking or negative properties, characteristic of this peculiar material.

It is not at all the intention of the writer to recall well known facts relating to the care required for the proper choice of the chemical constituents of cement, nor to dwell upon the peculiar manufacturing operations in the fusion of these materials and in their subsequent grinding. Nor is it necessary here to discuss the proper "ageing" of the cement, the need of special protection from moisture before use, and the varied questions of vital interest concerned with the selection of materials used as aggregate which enter with cement in making good concrete. All these considerations are assumed to be common knowledge.

On the other hand, the purpose of this discussion is to present certain specific kinds of misbehavior of the material in the ordinary circumstances of its use, with the idea of indicating how numerous are the conditions that have led to failure in its employment, and how at certain times it has been chosen for structures for which other materials were eminently fitted.

Builders do not permit themselves to consider as conclusive the failures of concrete in pavements and in pipes set forth by the manufacturers of brick and tile products, any more than they allow themselves to be held in terror by the possibility of a shower of bricks scattered abroad by an earthquake, as is the unhappy future predicted by some cement enthusiasts. It is impossible to be partisan in such a controversy.

The fundamental question that calls for answer is simply stated: Does this materal, concrete, supply those properties which combine to produce a suitable structure of the special type under consideration? Therefore, let us summarize the facts before us. Concrete, like cast iron, is eminently easy to cast in various peculiar forms; it is cheap when employed in suitable positions, mainly to resist compression, and it is invitingly simple to use. This last advantage is more imaginary than real. Opposed to these advantages, concrete has the disadvantage of being brittle, weak, almost worthless in tension and shear, heavy, subject to shrinkage and temperature cracks and to seams of weakness on surfaces separating new from older concrete. It is often pervious to water or subject to chemical disintegration. It is generally unsightly in color or surface markings; it looks "cheap" when placed to imitate other materials. Concrete is also liable to a great variety of freakish performances of considerable importance due to a number of apparently trivial causes. For successful application in many common structures, concrete must be placed continuously in extremely large quantities, as in the construction of water tanks and towers, in dams, arches, walls, beams, floors, sidewalks or pavements. This requires a costly bunching of the work of construction. In other applications, concrete must have its lacking qualities supplied through combination with other materials possessing these qualities, as for example, reinforcing steel for tension, metal webs for impervious joints, clay or asphalt for similar purposes or for expansion joints, and surfacing, facing, or special coloring to satisfy still other requirements.

A more extended discussion of these summarized advantages and disadvantages will now be presented. As its special advantage, concrete is particularly easy to cast in various useful and often artistic shapes. The main item controlling this advantage is obviously the mold or form into which the "molten" concrete, if it may be so termed, is poured, and which must quietly and firmly hold the concrete until it is set, that is for a period of not less then twenty-four hours under average temperature conditions. The advantage of this quality of concrete so far as cost is concerned can only be realized by the use of very cheap forms, or by such designs of forms as will permit their repeated use. The importance of this item is witnessed by the several recent types of building construction involving separately molded beams, slabs, columns, walls, lintels, sills, building blocks and pipes, and piles for foundation and for sheeting. Separately molded buildings and those having mortar walls, etc., plastered upon metal in various forms fastened to steel skeleton frames are certainly active competitors of all building structures of concrete molded in place. The writer has long believed that concrete should be generally used for manholes and flush tanks for sewer work 4 feet or slightly more in inside diameter, fairly cylindrical in shape, with a flat reinforced concrete slab with a hole to take the ordinary cast iron manhole frame and cover. The walls of the manholes in ground suited particularly to this method should have inside movable forms, preferably of steel, while the outside form should consist of the adjacent sides of the excavation, one and one half feet greater than the inside diameter of the manhole. In caving or loose ground the excavation should be much larger, 8 feet in diameter as a common maximum, while the outside forms should be removable and allow the tamping of the earth in place. The covers should be cast in a yard and hauled and set like ordinary stone covers.

Turning to the second advantage claimed for concrete, the types of structures specially adapted to the use of this material are dams, arch bridges, foundations, retaining walls, piers and basement columns. Most underground masonry structures are lately made of concrete, while those above ground to which the material has a special application are of a massive character.

Recently, the tendency in the employment of concrete for the exterior of large buildings and employing a smooth finish for the surface has been to define the massive character of the construction by heavy paneling, large projections, and, in general, by a provision for broad shadow effects. Where this is impossible, a slap dash treatment, left as rough as possible, that is, with projections of 1 inch or more, is believed to give a pleasing, truly genuine and characteristic surface to the material. Notwithstanding the arguments of some architects to the contrary, the presence of conspicuous board or other form marks is an eye-sore to a majority of people.

Concrete has the very valuable property of being simple to use. It is a natural assumption that the really skilful feature of the task has been completed when the cement is at hand in a fit condition for use. Still, evidence accumulates that a great share of the dissatisfaction with certain concrete structures is a result of an ignorance or carelessness concerning many little items which are hidden by the bulk of the labor and material so obvious during the mixing and placing of concrete. To some carpenters, the construction of forms means the enclosing of certain empty spaces. The feeling or sensing of those future conditions when the heavy, plastic material shall be placed in the forms, and shall exert its enormous pressures upon them, is not a possession of even our skilled workmen, unless they come by it after a season of training. Many workmen have no conception of the chemical changes during setting or hardening, and fail to correlate time period, quantity of water, protection from disturbance during set with temperature conditions. Examinations and reports on phases of concrete structures are particularly unsatisfactory by reason of the broad field of possible contingencies, any one of which, or any combination of several, may be assumed with reason to have been the proximate cause of failure.

Concrete and cement mortar when well applied are used with great success in rust protection. Examples in substantiation of this statement are so common that one may be expected to supply them from his own experience. There are cases in plenty, nevertheless, which have resulted in futile attempts in such applications. These failures have been due to the exposure of the concrete to attack by certain agents against which it has feeble qualities of resistance. Shrinkage and temperature cracks, or shattering due to blows, allow the entrance of air and water, whereupon the conditions favorable to rusting are complete. Attention should be directed more closely to certain of these feeble qualities of concrete which are inherent and which become prominent on subjection of the material to conditions calling for the special employment of these qualities.

In the first place, concrete is brittle and is weak in its resistance to direct pull and shearing action. Consequently, to overcome the resulting failures or surface breaks, the concrete must be protected. This is done by the use of brick, asphalt or other surfacing in the case of pavements, by metal edging or corner protection for curbs, by chamfering of sharp protruding edges, by the use of guard buffers or fenders of concrete for wheels, and by the use of piles or other timbers in the case of docks. All these and other devices follow rationally from the premise that the material is brittle and therefore, that it must be so placed or so protected as to insure safety from shocks and blows. Similarly, on account of the low shearing and tensile resistance, special constructions and designs must be employed to offset the disadvantages of the material in these respects. Such designs in each instance follow logically upon the recognition of these particular negative qualities.

The excessive heaviness of concrete, with its range of values from a minimum of something like 125 pounds per cubic foot for cinder, slag or lava concrete up to 160 pounds per cubic foot for the heaviest aggregates and maximum percentage of reinforcement, is likewise an important property. Structures with roof or floor slabs or beams require special treatment in designing to give strength sufficient to allow for the dead weight of the material itself. Particularly is this the case with respect to a great variety of form work and of false supports, upon which the dead weight of the fresh concrete constitutes the main load. Even though the latter are temporary structures, excessive unit stresses are not permissible unless calculations of deflection show no danger of distortion sufficient to impair the completed structure.

Shrinkage cracks in concrete work are particularly offensive to the eye, and may seriously injure a structure for its intended service. The use of extremely wet mixtures, unless plenty of labor is employed in puddling to remove the excess water and to consolidate the concrete, is a common cause of this trouble. The remedy lies in reinforcement correctly proportioned to distribute such cracks, or requires an intentional provision of joint planes having key-ways to preserve the structure intact while at the same time compelling the crack to occur in a sightly place and with a straight break. This is the main object of the cross grooves in side-walk work. The consideration of temperature cracks is of a similar character. On the other hand, those numerous "crazy" cracks denoted by the term "crazing" which frequently disfigure the surface of concrete rich in cement, are caused by surface shrinkage. They are not specially objectionable by reason of a weakening effect upon the structure, but rather on account of the appearance of the surface. They are prevented by any device which will provide plenty of water for the initial set of the concrete during the preliminary chemical and crystalizing changes.

The pervious character of ordinary concrete gives occasion for much further thought. The results of its permeability in some instances are undesirable leaks and often are permanent, white, surface discolorations. The precautions are several. The concrete may be mixed so as to be very dense, with a particular avoidance of planes of separation; it may be specially modified by the use of alum, soap, and the like, possibly even by the addition of oil, as has been suggested, so as to result in a more impervious mixture; it may be specially treated with a waterproof coat on the side next to the source of water. While it is hard to believe, even this last requirement is occasionally reversed, with a result of having the impervious coat applied on the. side where it is seldom of any avail.

Chemical disintegration of concrete occurs generally with seepage of water. This may carry in solution small quantities of acids or alkalies capable of dissolving portions of concrete, and, as a consequence, the cementing or bonding material is progressively removed. Finally a crumbling mass of sand and stone is left and the entire structure requires rebuilding. Fortunately, there are few instances in the east where the natural waters contain much of these solvent elements, and it is only in the storage of peculiarly corrosive materials that any considerable attention need be directed to the question of chemical disintegration.

Much more attention should be paid to surface appearance. One prerequisite to good surfacing is the construction of rigid forms. Wiring or bolting of forms should be done tightly against spreaders, and the forms should be lined truly before any concrete is placed. If any refinishing of the surface is to be attempted it must be accomplished while the concrete is still somewhat soft, at as early a stage as the concrete will bear removal of forms. The application of coloring materials is a subject for special study and experiment in each case. Some few treatments of this subject are available in the best current books on concrete, although no discussion is of any great length. The treatment of wires used for tying the forms together is often very careless. Projecting ends of wires are dangerous, unsightly and may cause disfiguring rust streaks on exposed walls. The cure is to nip wires off close and then to punch the bent end back into the wall, finally filling the small holes with a suitable mortar. Such puttying material should not in any case be made of cement alone without sand. All materials for patches should be carefully measured to agree in proportion with the mortar in the main body of concrete, and the same materials must be employed or a variation in color will make the patch prominent. Sometimes patches of the surfacing are pulled off on removal of the forms or stone pockets may be found. For broad flat patches, the successful method is to drill small holes with brace and bit into which screws may be securely driven. After a large number of screws are in place, mortar may be applied and will probably stay where it is put. The patching or resurfacing of old concrete is commonly unsuccssful on account of the difficulty of getting a good bond. It is a task for an expert workman in any case.

In this article, the writer has attempted to point out afresh the common, simple properties of concrete, and the logical results of a knowledge of those qualities; to suggest broadly the field open to the successful use of concrete; to indicate its specific disadvantages; and finally, to call to mind the very evident expense attending the unskilled use of this material. It is earnestly hoped that to such a necessarily brief outline, the details of many an individual experience may add a rounded completeness and may result in direct personal benefit.

SPECIFICATIONS FOR BRICK PAVEMENTS

RECOMMENDED BY COMMITTEE ON STANDARD SPECIFICATIONS

Adopted by the Society September 27, 1911 and amended November 13, 1912

PART I. THE BRICK

CHARACTER OF BRICK

Section 1. All brick must be strictly No. 1 pavers of the sizes commercially known as "vitrified block," and "brick," the widths of which must not vary more than one-eighth ($\frac{1}{8}$) of an inch. They must be thoroughly annealed, tough and durable, regular in size, shape, and evenly burned.

When broken, the brick shall show a dense, stone-like body, free from lime, air pockets, cracks or marked laminations. Kiln marks must not exceed three-sixteenths ($\frac{3}{16}$) of an inch, and one edge at least shall show but slight kiln marks. All brick so distorted in burning as to lay unevenly in the pavement shall be rejected.

The standard size of brick shall be two and one-half ($2\frac{1}{2}$) inches in width, four (4) inches in depth and eight and one-half ($8\frac{1}{2}$) inches in length; and the standard size of block three and one-half ($3\frac{1}{2}$) inches in width, four (4) inches in depth, and eight and one-half ($8\frac{1}{2}$) inches in length. They shall not vary from these dimensions to exceed one-eighth ($\frac{1}{8}$) of an inch in width and depth, and not more than one-half ($\frac{1}{2}$) inch in length. If the edges of the brick are rounded, the radius shall not exceed three-sixteenths ($\frac{3}{16}$) of an inch. Only brick with raised lugs on one side not to exceed one-fourth ($\frac{1}{4}$) inch in height shall be used.

INSPECTION

Section 2. All brick shall be subject to thorough inspection before and after laying and rolling, and all rejected material shall be immediately removed from the street.

DELIVERY OF BRICK

Section 3. The brick shall be hauled, carefully unloaded by hand, and neatly piled on the walks or outside of the curbs before the grading is finished, and in laying shall be carried from there to the pavement.

RATTLER TEST FOR BLOCK SIZE

Section 4. The brick shall not lose of their weight more than 22 per cent after being submitted to the following tests:

Samples of brick of uniform shape and appearance shall be taken from each car (estimated at 10,000 brick). Brick having a defect that would cull them shall not be used. Three grades of samples shall be tested, one of the softest, one of the medium and one of the hardest burned. If all of the tests overrun the above percentage of loss, the car shall be rejected. If one or two of the tests overrun, another test of said grade or grades shall be made. Should only one of these tests overrun the specified percentage of loss, the contractor may cull said grade, provided they do not exceed ten (10) per cent of the amount of brick in the car, and deliver the balance on the improvement. Otherwise, the whole car will be rejected.

In order to prevent the continued shipments of inferior brick, only two cars of two separate shipments of any make of brick will be tested. Should they fail to meet the requirements stated above, said make of brick will be rejected for this improvement.

NUMBER AND CONDITION OF BRICK

Section 5. Ten paving brick shall constitute the number to be used in a single test. The brick shall be thoroughly dried for at least three (3) hours, in a temperature of one hundred (100)° Fahr., before testing.

TESTS BEFORE UNLOADING

Section 6. The contractor shall notify the proper city official of the location and car number of each carload of brick received. Samples from such car shall be taken and tested by the city, and no brick shall be delivered on or adjacent to any improvement on which the brick are to be used until a written statement has been received from the engineer or his authorized representative, that the samples have passed the required tests. Decision relative to each carload will be made within twenty-four (24) hours of notice. Permission to deliver brick on the line of work shall not be considered a final acceptance in any respect.

MAKING THE RATTLER TEST

Section 7. The Rattler. The machine shall be of good mechanical construction, self-contained, and shall conform to the following details of material and dimensions, and shall consist of barrel, frame and driving mechanism as herein described.

The barrel. The barrel of the machine shall be made up of the heads, headliners and staves.

The heads shall be cast with trunions in one piece. The trunion bearings shall not be less than two and one-half (2½) inches in diameter or less than six (6) inches in length.

The heads shall not be less than three-fourths (¾) inch thick nor more than seven-eighths (⅞) inch. In outline they shall be a regular fourteen-sided (14) polygon inscribed in a circle twenty-eight and three-eighths (28⅜) inches in diameter. The heads shall be provided with flanges not less than three-fourths (¾) inch thick and extending outward two and one-half (2½) inches from the inside face of head to afford a means of fastening the staves. The flanges shall be slotted on the outer edge, so as to provide for two (2) three-fourths (¾) inch bolts at each end of each stave, said slots to be thirteen-sixteenths ($\frac{13}{16}$) inch wide and two and three-fourths (2¾) inches center to center. Under each section of the flanges there shall be a brace three-eighths (⅜) inch thick and extending down the outside of the head not less than two (2) inches. Each slot shall be provided with recess for bolt head, which shall act to prevent the turning of the same. There shall be for each head a cast iron headliner one (1) inch in thickness and conforming to the outline of the head but inscribed in a circle twenty-eight and one-eight (28⅛) inches in diameter. This liner or wear plate shall be fastened to the head by seven (7) five-eights (⅝) inch cap screws, through the head from the outside. These wear plates, whenever they become worn down one-half (½) inch below their initial surface level, at any point of their surface, must be replaced with new. The metal of which these wear plates are to be composed shall be what is known as hard machinery iron, and must contain not less than one (1) per cent of combined carbon. The faces of the polygon must be smooth and give uniform bearing for the staves. To secure the desired uniform bearing the faces of the head may be ground or machined.

The staves. The staves shall be made of six (6) inch medium steel structural channels twenty-seven and one-fourth (27¼) inches long and weighing fifteen and five-tenths (15.5) pounds per lineal foot.

The channels shall be drilled with holes thirteen-sixteenths ($\frac{13}{16}$) inch in diameter, two (2) in each end, for bolts to fasten same to head, the center line of the holes being one (1) inch from either end and one and three-eighths (1⅜) inches either way from the longitudinal center line.

The spaces between the staves will be determined by the accuracy of the heads, but must not exceed five-sixteenths ($\frac{5}{16}$) inch. The interior or flat side of each channel must be protected by a lining or wear plate three-eighths (⅜) inch thick by five and one-half (5½) inches wide by nineteen and three-fourths (19¾) inches long. The wear plate shall consist of medium steel plate, and shall be riveted to the channel by three (3) one-half (½) inch rivets, one of which shall be on the center line both ways and the other two on the longitudinal center line and spaced seven (7) inches from the center each way. The rivet holes shall be counter-sunk on the face of the wear plate and the rivets shall be driven hot and chipped off flush with the surface of the wear plate. These wear plates shall be inspected from time to time, and if found loose shall be at once reriveted, but no wear plate shall be replaced by a new one except as the whole set is changed. No set of wear plates shall be used for more than one hundred and fifty (150) tests under any circumstances. The record must show the date when each set of wear plates goes into service and the number of tests made upon each set.

The staves when bolted to the heads shall form a barrel twenty (20) inches long, inside measurement, between wear plates. The wear plates of the staves must be so placed as to drop between the wear plates of the heads. These staves shall be bolted tightly to the heads by four (4) three-fourths (¾) inch bolts, and each bolt shall be provided with lock nuts, and shall be inspected at not less frequent intervals than every fifth (5th) test and all nuts kept tight. A record shall be made after each such inspection, showing in what condition the bolts were found.

The frame and driving mechanism. The barrel shall be mounted on a cast-iron frame of sufficient strength and rigidity to support same without undue vibration. This shall rest on a rigid foundation and be fastened to same by bolts at not less than four (4) points.

It shall be driven by gearing whose ratio of driver to driven shall not be less than one (1) to four (4). The counter shaft upon which the driving pinion is mounted shall nor be less than one and fifteen-sixteenths (1$\frac{15}{16}$) inches in diameter, with bearings not less than six (6) inches in length and belt driven, and the pulley shall not be less than eighteen (18) inches in diameter and six and one-half (6½) inches in face. A belt of six (6) inch double-strength leather, properly adjusted so as to avoid unnecessary slipping, shall be used.

THE ABRASIVE CHARGE

Section 8. The abrasive charge shall consist of two sizes of cast-iron spheres. The larger size shall be three and seventy-five-hundredth (3.75) inches in diameter when new and shall weigh when new approximately seven and five-tenths (7.5) pounds (3.40 kilos) each. Ten shall be used.

These shall be weighed separately after each ten (10) tests, and if the weight of any large shot falls to seven (7) pounds (3.175 kilos) it shall be discarded and a new one substituted; provided, however, that all of the large shot shall not be discarded and substituted by new ones at any single time, and that so far as possible the large shots shall compose a graduated series in various stages of wear.

The smaller size spheres shall be, when new, one and eight hundred seventy-five-thousands (1.875) inches in diameter and shall weigh not to exceed ninety-five-hundredths (0.95) pound (0.430 kilo) each. Of these spheres so many shall be used as will bring the collective weight of the large and small spheres most nearly to three hundred (300) pounds, provided that no small sphere shall be retained in use after it has been worn down so that it will pass a circular hole one and seventy-five-hundredths (1.75) inches in diameter, drilled in cast-iron plate one-fourth (¼) inch in thickness, or weigh less than seventy-five-hundredths (0.75) pound (or 0.34 kilo). Further, the small spheres shall be tested after every ten tests, by passing them over such an iron plate drilled with such holes, or by weighing, and any which pass through or fall below the specified weight shall be replaced by new spheres; provided, further, that all of the small spheres shall not be rejected and replaced by new ones at any one time, and that so far as possible the small spheres shall compose a graduated series in various stages of wear. If at any time any sphere is found to be broken or defective it shall at once be replaced.

The iron composing these spheres shall have a chemical composition within the following limits:

	Per Cent
Combined carbon—not less than	2.50
Graphitic carbon—not more than	0.10
Silicon—not more than	1.00
Manganese—not more than	0.50
Phosphorus—not more than	0.25
Sulphur—not more than	0.08

For each new batch of spheres used the chemical analysis must be furnished by the maker, or be obtained by the user, before introduction into the charge; and unless the analysis meets the above specifications, the batch of spheres shall be rejected.

THE TEST

Section 9. The rattler shall be rotated at a rate of not less than 29½ nor more than 30½ revolutions per minute, and 1800 revolutions shall constitute the standard test. A counting machine shall be attached to the rattler for counting the revolutions.

A margin of not to exceed ten revolutions will be allowed for stopping. In case a charge is allowed to run several minutes beyond its proper termination, and the loss incurred is still within the prescribed limits, then the test shall not be discarded, but the fact shall be entered on the record.

Stopping and starting. Only one start and stop per test is regular and acceptable. If from accidental causes a test is stopped and started twice extra, and the loss exceeds the maximum permissible, the test shall be disqualified and another made.

THE RESULTS

Section 10. The loss shall be calculated in percentage of the original weight of the dried brick composing the charge. In weighing the rattled brick, any piece weighing less than one (1) pound shall be rejected.

THE RECORD

Section 11. Description. The operator shall keep an official book, in which the alternate pages are perforated for removal. The record shall be kept in duplicate, by use of a carbon paper between the first and second sheets, and when all entries are made and calculations are completed, the original record shall be removed and the carbon duplicate preserved in the book. All calculations must be made in the space left for that purpose in the record blank, and the actual figures must appear. The record must bear its serial number and be filled out completely for each test and all data as to dates of inspections, weighing of shot, and replacement of worn out parts must be carefully entered, so that the records remaining in the book constitute a continuous one. In event of further copies of a record being needed, they may be furnished on separate sheets, but in no case shall the original carbon copy be removed from the record book.

The blank form upon which the record of all official brick tests is to be kept and reported is as follows:

REPORT OF STANDARD RATTLER TEST OF PAVING BRICKS
IDENTIFICATION DATA (Serial No.)

Name of firm furnishing sample..
Name of the firm manufacturing sample..................................
Street or job which sample represents....................................
Brands or marks on the brick..
Quantity furnished..................Drying treatment.................
Date received.......................Date tested.......................
Length...........Breadth..........Thickness...........................

Standardization data

Number of charges tested since last inspection..........................
....
Weight of charge (after standardization)..,...............................
Condition of locknuts on staves...
Condition of scales...
10 large spheres..
small spheres...
Total..
Number of charges tested since stave linings were renewed..............
Repairs (Note any repairs affecting the condition of the barrel)..........

Running data

	Time readings	Revolution counter readings	Running notes, stops, etc.
	hours minutes seconds		
Beginning of test......	....	....	....
Final reading..........	....	....	....

Weights and calculations

Initial weight of 10 bricks...
Final weight of same...
Loss of weight.......................Percentage Loss..................
(Note: The calculations must appear)
....
Number of broken bricks and remarks on same..........................

I certify that the foregoing test was made under the specifications of...................................and is a true record.

Signature of Tester.................................
Date Location of Laboratory.
....

PART II. CONSTRUCTION OF THE PAVEMENT

FOUNDATION

Section 12. The cement used shall conform to the requirements specified in Section 21. The fine aggregate shall consist of any material of siliceous or igneous origin, free from mica in excess of five per cent, and other impurities, uniformly graded, the particles ranging in size from ¼ inch to that which will pass a No. 100 standard sieve. The coarse aggregate shall be sound gravel, broken stone or slag, having a specific gravity of not less than 2.6. It shall be free from all foreign matter, uniformly graded, and shall range in size from ¼ inch up, the largest particles not to exceed in any dimension one-half the thickness of the concrete in place.

In preparing the concrete, the cement and aggregate shall be measured separately and then mixed in such proportions that the resulting concrete shall contain fine aggregate amounting to one-half of the volume of the coarse aggregate; and that seven cubic feet of concrete in place will contain ninety-four pounds of cement.

The ingredients of the concrete shall be thoroughly mixed, sufficient water being added to obtain the desired consistency, and the mixing continued until the materials are uniformly distributed, and each particle of the fine aggregate is thoroughly coated with cement, and each particle of the coarse aggregate is thoroughly coated with mortar.

When a mechanical concrete mixer is used, the materials must be proportioned dry, and then deposited in the mixer all at the same time. The mixer must produce a concrete of uniform consistency and color, with the stones thoroughly mixed with the water, sand and cement.

The materials shall be mixed wet enough to produce a concrete of a consistency that will flush readily under light tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

Re-tempering, that is, remixing with additional water, mortar or concrete that has partially hardened, will not be permitted.

The concrete shall be deposited in a layer on the sub-grade in such quantities that, after being thoroughly rammed in place, it will be of the required thickness, and the upper surface shall be true, uniform and parallel with the surface of the finished pavement.

In conveying the concrete from the place of mixing to the place of deposit, the operation must be conducted in such a manner that no mortar will be lost and the concrete must be so handled that the foundation will be of uniform composition throughout, showing no excess nor lack of mortar in any place.

The foundation shall be 6 inches in thickness, with its upper surface finished parallel to and 5½ inches below the grade of the finished pavement.

When complete, the foundation shall be kept moist for not less than 2 days and it shall be protected from traffic until the concrete has thoroughly set.

No concrete shall be mixed while the air temperature is below 32° F., and in no case shall any material containing frost be used; and if this temperature is reached at any time before the foundation shall have been thoroughly set, it shall be immediately provided with such covering as will protect it from all damage.

In no event shall a concrete foundation be laid on a frozen sub-grade.

SAND CUSHION

Section 13. Over the foundation, which must be thoroughly cleaned, shall be spread to a uniform depth of one and one-half (1½) inches (after rolling), a cushion of clean, sharp sand, free from loam or foreign matter. The sand must pass a one-quarter (¼) inch screen.

The cushion shall be carefully shaped to a true cross-section of the roadway by means of a template having a steel faced edge, covering at least one-half (½) the width of the brick work, and so fitted with rollers as to be easily drawn on the curb and guide timbers or rail.

Section 14. Template. The template shall be built in substantial accordance with the plan accompanying these specifications.

Section 15. Guide timbers. Guide timbers shall be one and one-half (1½) inches by four (4) inches by sixteen (16) feet, dressed on two sides, laid to a true surface in the center of the street, and also next to the curb if the curb cannot be used.

Section 16. Shaping cushion. Before shaping the cushion a one-half (½) inch strip shall be laid on the curb, and guide timbers, or rail, and the template drawn over the same, after which the one-half (½) inch strip shall be removed, the cushion slightly moistened and rolled over its entire surface with a hand roller. The roller shall not be less than thirty-six (36) inches in diameter, twenty-four (24) inches in width, and shall weigh not less than ten

(10) pounds per inch in width, and have a handle twelve (12) feet in length. After rolling, the template shall be drawn over the curb and guide timbers or rail, to complete the cushion. The cushion shall be prepared at least fifty (50) feet in advance of the brick laying.

LAYING THE BRICK

Section 17. The brick shall be laid in straight lines on edge, at right angles to the curb. At intersections they shall be laid as directed. Brick shall be laid with the lug sides all in the same direction. Brick must be placed close together, both ends and sides, breaking joints at least three (3) inches. At every fourth course the brick shall be driven together to secure tight joints and straight courses, and all thick brick shall be removed. Brick shall be used with the best edge up.

When any section shall contain more than ten (10) per cent of culls, the brick shall be taken up and the cushion adjusted. Brick shall be laid from curb to curb, or car track to curb.

No bats or broken brick shall be used except at curbs or at street car tracks. Batting for closures shall immediately follow the laying.

Joints shall be cut square with the top and sides of the brick. All joints must be kept clean and open to the bottom until filled as specified.

STREET CAR TRACKS

Section 18. Along the street car tracks the brick must not be laid within one-quarter ($\frac{1}{4}$) of an inch of the rail, and when rolled shall be one-quarter ($\frac{1}{4}$) inch below the top of the rail.

The space between the web of the rail and the brick shall be filled with cement mortar, consisting of two (2) parts sand and (1) part Portland cement. The mortar shall be in proper condition and the edge constructed to a straight line before the brick are laid.

EXPANSION JOINTS FOR CEMENT GROUT FILLER

Section 19. Expansion joints shall be placed parallel with and at each of the curb lines, and shall be one and one-half ($1\frac{1}{2}$) inches in width. The joints shall be made by placing together on edge, parallel with the curb, two wedge-shaped strips six (6) inches in width, and dressed on two faces. The strip next to the curb shall be one (1) inch wide on top, beveled to a thickness of one-half (½) inch at the bottom, and the strip next to the brick shall be of the same dimensions and placed in a reverse position. The brick shall be laid lightly against said strips. Soon after the pavement has been grouted, and the cement filler has set, and the pavement is in all other respects finished, the strips shall be removed, the joints thoroughly cleaned out, and immediately completely filled with a bituminous filler composed of a material which, when penetrated by a No. 2 needle under a weight of 200 grams for one (1) minute at a temperature of 32° Fahr., will have a penetration of not less than 20, and when penetrated by a No. 2 needle under 50 grams for five (5) seconds in a temperature of 115° Fahr., will not have a penetration of over 100.

ROLLING

Section 20 After the brick in the pavement have been passed for rolling and the surface swept clean, the pavement shall be rolled with a roller weighing not less than three (3) nor more than five (5) tons, in the following manner: The brick next the curb shall be tamped with a hard wood tamper, to the proper grade. The rolling shall then commence near the curb at a very slow pace, and continue back and forth toward the center, until the center of the street is reached; then, passing to the opposite curb, it shall be repeated in the same manner to the center of the street. After this first passing of the roller the pace may be quickened and the rolling continued until each brick is firmly embedded in the sand cushion. The pavement shall then be rolled transversely at an angle of forty-five (45) degrees from curb to curb, repeating the rolling in the opposite forty-five (45) degree direction. Before and after this transverse rolling has taken place, all broken or injured brick must be taken up and replaced with perfect ones. The substitute brick must be brought to the true surface by tamping.

After final rolling the pavement shall be tested with a ten (10) foot straight edge, laid parallel with the curb, and any depression exceeding one-quarter (¼) of an inch must be taken out. If necessary, the pavement shall be again rolled.

PORTLAND CEMENT GROUT FILLER

Section 21a. The filler shall be composed of one part each of fine, clean, sharp sand and Portland cement.

The cement shall meet the requirements of the standard specifications for Portland cement of the American Society for Testing Materials, adopted August 16, 1909, with subsequent amendments.

The sand shall pass a No. 20 standard sieve. Sand shall be measured in a box having the same cubical contents as one sack of cement.

One sack of cement with an equal amount of sand shall be thoroughly mixed together dry in a box preferably about four (4) feet eight (8) inches long, thirty (30) inches wide, and fourteen (14) inches deep, resting on legs of different lengths, so that the mixture will rapidly flow to the lower corner of the box, the bottom of which shall be about three (3) inches above the pavement. One box shall be used for each fourteen (14) feet in width of roadway, and at least two (2) boxes must be used in all cases.

After the cement and sand have been thoroughly mixed until the mass assumes a uniform color, enough clean water shall be added to obtain a grout that will give the best results. From the time the water is applied until the last drop is removed and floated into the joints of the pavement, the mixture must be kept in constant motion. Before the grout is applied the brick shall be thoroughly wet by being gently sprayed.

The grout shall be removed from the box with scoop shovels and applied to the brick in front of the sweepers, who shall rapidly sweep it lengthwise of the brick into the unfilled joints, until the joints are filed to within not more than one (1) inch of the top of the brick. After the grout has had a chance to settle into the joint and before the initial set develops, the balance of every joint shall be filled with a thicker grout, and, if necessary, refilled, until the joints remain full to the top.

After this application has had time to settle and before the initial set takes place, the pavement shall be finished to a smooth surface with a squegee or wooden scraper having a rubber edge, which shall be worked over the brick at an angle with the brick.

When completed and the cement has received its initial set, the pavement shall be covered with a one-half (½) inch layer of sand, which shall be frequently sprinkled in warm weather. No travel shall be permitted on the pavement for a period of at least seven (7) days after grouting, or longer, as the engineer may require on account of weather conditions.

Ample barricades and watchmen shall be provided by the contractor for the proper protection to the grouting.

COAL TAR PAVING PITCH FILLER

Section 21b. The joints or spaces between the bricks, and those between the bricks and the curb, railroad tracks, around manholes, etc., shall be filled with coal tar paving pitch, which shall comply with the following requirements:

Physical properties. When in place in the pavement, it shall be of such character that it will adhere firmly to the paving brick and to the curb, and shall be sufficiently plastic to allow for the contraction and expansion in the pavement without developing cracks in the joints. The filler shall be such that it retain its consistency under extreme temperature. It shall be proof against action by water and all acids and alkalis to which the pavement may be exposed.

The free carbon shall not be less than 25% nor more than 40%. The specific gravity shall not be less than 1.23 nor more than 1.30 at 60° Fahr.

Melting point. It shall have a melting point varying not more than 5 degrees from 135° Fahr., determined by the cube method (hereinafter described).

Methods of use. The filler shall be heated and poured into the joints to the full depth thereof, at a temperature of not less than 300° Fahr., nor greater than 350° Fahr. All joints shall be completely filled at the top. The top dressing of sand shall be spread over the pavement immediately after the filler is applied and while it is still soft. In cold weather the sand shall be heated so as to readily bond with the pitch. Extra care shall be used at the gutters and around catch basins, etc., to effectually prevent the leakage of water into the sub-roadway.

Test for melting point of pitch filler. A clean shaped one-half (½) inch cube of the pitch is to be formed in the mold and suspended in the beaker so that the bottom of the pitch to be tested is one (1) inch above the bottom of the beaker. The pitch is to remain for five (5) minutes in water of a temperature of 60° Fahr. before heat is applied. Heat is to be applied in such a manner that the temperature of the water is raised 9° Fahr. each minute. The temperature recorded by the thermometer at the instant the pitch touches the bottom of the beaker to be considered the melting point.

ASPHALT FILLER

Section 21c. The interstices of the brick shall be completely filled with an asphalt filler heated to a temperature of not less than 350° Fahr. nor more than 450° Fahr. This asphalt filler shall not contain pitch nor any part of coal tar. It shall contain at least ninety-eight (98) per cent of bitumen soluble in carbon disulphide. It shall remain pliable at all temperatures to which it may be subjected as a street paving filler; it shall be absolutely proof against water and street liquids; it shall firmly adhere to the brick and be pliable rather than rigid. Care shall be exercised to completely fill all openings around street structures and the street shall not be used for traffic until the filler is completely set. A top dressing of sand shall be spread immediately after the filler is applied and while it is still soft.

The penetration shall conform to the following:

No. 2 Needle, 5 sec., 100 grams at 77° F., 25 to 60.
No. 2 Needle, 1 min., 200 grams at 32° F., not below 25.
No. 2 Needle, 5 sec., 20 grams at 115° F., not above 110.

MAINTENANCE

Section 22. The period of guaranty shall be five (5) years. During the period of guaranty, whenever the surface of a vitrified brick pavement becomes uneven, holding water one-fourth (¼) of an inch or more in depth in a distance of four feet or less, or when the pavement has settled over trenches existing previous to the completion of the pavement, then the brick shall be taken up and relaid to proper crown and grade.

Any brick which may be found soft, unsound, broken or disintegrated, and all portions of the pavement which may have become rough by reason of the chipping or breaking of the edges of the brick, so as to produce joints exceeding one-half (½) inch at a point one-quarter (¼) inch below the surface of the brick, shall be removed, and properly replaced with sound material.

NOTE TO ENGINEER: *Section 1.* Whenever the word "brick" is used in these specifications it is intended to refer to either brick or block, whichever may be used, except in Section 4.

Section 4. Where medium or light traffic or other conditions exist which, in the opinion of the engineer, do not require a brick capable of giving an abrasive loss of only 22 per cent, brick of a quality which will give a loss of 25 per cent or even 28 per cent may be used.

Inasmuch as the committee has not made any tests of the brick size, it is not prepared to recommend specific abrasion loss for that size.

Section 21. While the committee is in favor of a cement grout filler, it believes that where conditions do not favor the use of the same a bituminous filler may be used, for which it recommends Section 21b or 21c in place of 21a.

SPECIFICATIONS FOR ASPHALT PAVEMENT

RECOMMENDED BY COMMITTEE ON STANDARD SPECIFICATIONS

Adopted by the Society September 27, 1911 and amended November 13, 1912

GENERAL DESCRIPTION

Upon the foundation prepared and laid as elsewhere herein specified, shall be laid the pavement proper. This shall consist of:

1. A binder course . . . . inches in thickness when compressed.
2. An asphalt wearing surface . . . . inches in thickness when compressed.

MATERIALS

The materials used must comply with the requirements of these specifications and be suitable for use upon the street or streets to be paved. They shall be mixed in definite proportions by weight, depending upon their character, and the traffic upon the street, and upon the character of the materials used, and such materials and proportions must be satisfactory to the engineer.

Methods of testing. All tests herein specified must be conducted according to official methods on file in the office of the engineer. All penetrations at 77° Fahrenheit are expressed in hundredths of a centimeter and are to be taken (except where otherwise specified) with a No. 2 needle acting for five seconds under a total weight of 100 grams.

Refined asphalts. The refined asphalts admitted under these specifications shall be prepared from a natural mineral bitumen, either solid or liquid, or from combinations thereof, by suitable and approved methods of refining.

The preparation and refining of all asphalts admitted under these specifications shall be subject to such inspection at the paving plants and refineries as the engineer may direct and shall in all cases be conducted after the most approved manner. Every refined asphalt admitted under these specifications shall be equal in quality to the recognized standard for its particular kind or type of asphalt. If desired, the contractor may use an asphalt cement prepared at the refinery. To be acceptable, this asphalt cement must comply with the foregoing general requirements for refined asphalt, as well as requirements *a*, *b*, *c*, *d* and *e* for asphalt cement.

All refined asphalts admitted under these specifications must also comply with the following requirements:

a. All shipments of refined asphalt of any one kind shall be uniform in consistency and composition and shall not vary more than 15 points in penetration at 77° F.

b. Ninety-eight and one-half per cent of the total bitumen of all refined asphalts shall be soluble in carbon tetrachloride.

c. When made into an asphalt cement by the use of such materials and methods as are described in these specifications, they must produce an asphalt cement complying with all the requirements elsewhere set forth herein for asphalt cements.

Fluxes. These shall be the residues obtained by the distillation of paraffine, asphaltic or semi-asphaltic petroleums. They shall be of such character that they will combine with the asphalt to be used to form an acceptable and approved asphalt cement complying with the requirements of these specifications. All residuums must pass the following general tests:

a. They must have a penetration greater than 350 with a No. 2 needle at 77° F. under 50 grams weight for five seconds.

b. They shall have a specific gravity at 60° F. between 0.92 and 1.04.

c. When heated for five hours at 325° F. in a tin box 2½ inches in diameter after the manner officially prescribed, they shall not lose more than 5 per cent by weight and the residue left after such heating shall flow at 77° F.

d. They shall not flash below 350° F. when tested in a New York State closed oil tester.

e. They shall be soluble in carbon disulphide to the extent of not less than 99.5 per cent.

Binder stone. This shall be clean, hard stone, free from any particles that have been weathered, or are soft. It shall all pass a 1½-inch screen. Not less than 85 per cent of the stone shall pass this screen in its largest dimension, and of the remaining 15

per cent, no piece shall have a larger dimension than two inches. The stone shall be so graded from coarse to fine as to have the following mesh composition (sieves to be used in the order named)
Passing

10 mesh 15 to 35%	Total passing 2 mesh, 25 to 50%.	Total passing 1 mesh, 45 to 85%
2 mesh and retained on 10 mesh, 10 to 35%		
1 mesh and retained on 2 mesh, 20 to 60%	Total passing 1¼ inch mesh, 50 to 75%	
1¼ inch mesh and retained on 1 mesh, 15 to 55%		

The above limits as to mesh composition are intended to provide for such permissible variations as may be rendered necessary by the available sources of supply and the character of the work to be done. The mesh composition and character of the stone may be varied, within the limits above specified, at the discretion of the engineer, depending upon the kind of asphalt used and the traffic conditions upon the street or streets to be paved.

Sand. The sand shall be hard, clean grained and moderately sharp. On sifting it shall have the following mesh composition, (sieves to be used in the order named):
Passing

200 mesh 0 to 5%	Total passing 80 mesh and retained on 200 mesh, 20 to 35%
100 mesh and retained on 200 mesh, 10 to 25%	
80 mesh and retained on 100 mesh, 6 to 20%	
50 mesh and retained on 80 mesh, 15 to 40%	
40 mesh and retained on 50 mesh, 10 to 30%	
30 mesh and retained on 40 mesh, 8 to 25%	
20 mesh and retained on 30 mesh, 5 to 15%	
10 mesh and retained on 20 mesh, 2 to 10%	
8 mesh and retained on 10 mesh, 0 to 5%	

On very light traffic streets a coarser sand may be used with the approval of the engineer, but in no case shall a sand be employed that contains less than a total of 15 per cent passing an 80 mesh sieve, such total to contain not more than .5 per cent (calculated on the original sand) passing a 200 mesh sieve, or a mixture of 75 per cent of sand of the character above specified and 25 per cent of stone screenings passing a ¼-inch screen and retained on a No. 10 screen may be employed.

The above limits as to mesh composition are intended to provide for such permissible variations as may be rendered necessary by the available sources of supply and the character of the work to be done. The mesh composition and character of the sand may be varied, within the limits above specified, at the discretion of the engineer, depending upon the kind of asphalt used and the traffic conditions upon the street or streets to be paved.

Filler. This shall be thoroughly dry limestone dust or dust from other equally satisfactory stone or Portland cement, the whole of which shall pass a 30 mesh per linear inch screen and at least 66 per cent of which shall pass a 200 mesh per linear inch screen. The surface mixture shall contain from 6 to 20 per cent of this filler, depending upon the kind of sand and asphalt used and the traffic conditions upon the street or streets to be paved.

Samples. One pound samples of the refined asphalt, petroleum flux and asphalt cement that the contractor proposes to use in his work, together with a statement as to the source, character and proportions of the materials composing them, must be handed in with his bid and no contract shall be awarded to any bidder whose samples do not comply in every respect with these specifications. No asphalt other than that specified in his bid shall be used by any contractor except with the written consent of the engineer.

In addition to the samples submitted with the bid, other samples taken from and actually representative of the refined asphalt, petroleum flux, sand and filler to be used upon the street shall be submitted to the engineer before the use of such materials in the work is permitted. Except at his option, no work on binder or surface shall be commenced within three weeks from the date when such samples were submitted and in no case shall they be used until they have been examined and approved by him. Whenever, during the course of the work, new deliveries of paving materials are received by the contractor, samples of these shall at once be submitted to the engineer and their use in the work will not be permitted until they have been examined and approved by him.

ASPHALT CEMENT

Preparation. The asphalt cement shall be composed of refined asphalt, or asphalts and flux, where flux is required, of the character elsewhere herein specified and must be of a suitable degree of penetration.

The proper proportions of the refined asphalt, or asphalts and flux, shall be melted together and thoroughly agitated by suitable appliances until they are completely blended into a homogeneous asphalt cement. The asphalt cement must never be heated to a temperature exceeding 350° F. If the asphalt cement contains material that will separate by subsidence while it is in a molten condition, it must be thoroughly agitated before drawing from storage and while in use in the supply kettles. Approved methods of agitation, which will not injure the cement, must be used.

The refined asphalt or asphalts and flux comprising the asphalt cement shall, when required, be weighed separately in the presence of the authorized inspectors or agents of the engineer.

Requirements. The asphalt cement shall comply with the following requirements:

a. It shall be thoroughly homogeneous and the various bituminous ingredients contained in it shall be in a state of complete solution. It shall not be oily to the touch.

b. It shall have a penetration between 40 and 75 at 77° F., depending upon the sand and asphalt used and the traffic upon the street on which the pavement is to be laid.

c. It shall not flash below 300° F. when tested in a New York State closed oil tester.

d. When heated in an open tin at a temperature of 325° F. for five hours in a hot air oven, it must not show a loss by volatilization of over 5 per cent and the penetration at 77° F. of the residue left after such heating must not be less than one-half the penetration at 77° F. of the original sample before heating.

e. When the pure bitumen of the asphalt cement is brought to a penetration at 77° F. of 50 and made into a briquette having a cross section of 1 sq. cm., it shall have a ductility of not less than 20 cms. at 77° F.; the two ends of the briquette to be pulled apart at the uniform rate of 5 cm. per minute.

When the asphalt cement as used has a penetration greater than 50 at 77° F., an increased ductility of 2 cms. shall be required for every 5 points in penetration above 50 penetration.

BINDER

Preparation. The binder shall be composed of stone and asphalt cement of the character elsewhere herein specified and mixed in proper proportions. If the stone does not contain the proper amount of material passing the ½-inch screen, the deficiency may be made up by the addition of gravel or sand. The stone and the asphalt cement shall be heated separately to such a temperature as will give, after mixing, a binder mixture of the proper temperature for the materials employed. The stone when used must be at a temperature between 200 and 325° F. The asphalt cement when used must be at a temperature between 250 and 350° F. The asphalt cement and stone shall be thoroughly mixed by machinery in such proportions that the resulting binder shall have life and gloss without an excess of asphalt cement and the mixing shall be continued until a homogeneous mixture is produced in which all the particles are thoroughly coated with asphalt cement.

Laying. The binder mixture prepared in the manner above described shall be brought to the street in wagons at a temperature between 200° F. and 325° F. and shall be covered with canvas covers while in transit. The temperature of the binder mixture within these limits shall be regulated according to the temperature of the atmosphere and the working of the binder. On reaching the street it shall at once be dumped on the concrete and then be deposited roughly in place by means of hot shovels after which it shall be uniformly spread by means of hot iron rakes and then at once be thoroughly compacted by tamping or rolling. The depth of the finished binder shall at no place be less than one inch or more than three inches and its upper surface shall be parallel to the surface of the pavement to be laid. The surface, after compression, shall show at no place an excess of asphalt cement and any spot covering an area of one square foot or more showing an excess of asphalt cement shall be cut out and replaced with other material. Smaller spots may be dried by the use of stone dust and smoothers. All binder that shows lack of bond or that is in any way defective or which may become broken up before it is covered with wearing surface must be taken up and removed from the street and replaced by good material properly laid in accordance with these specifications, at the expense of the contractor. No more binder shall be laid at any one time than can be covered by two days' run of the paving plant on surface mixture. Binder when laid shall be followed and covered with wearing surface as soon as is practicable in order to effect the most thorough bond between the binder and the wearing course. The binder course shall be kept as clean and as free from traffic as is possible under working conditions. If necessary it must be swept off immediately before laying the wearing surface on it.

No binder shall be laid when in the opinion of the engineer the weather conditions are unsuitable or unless the concrete on which it is to be laid is dry and has set a sufficient length of time.

Requirements. The finished binder must contain from 5 to 8 per cent of bitumen soluble in cold carbon disulphide and from 15 to 30 per cent of material passing a 10 mesh screen, the percentage of bitumen to be regulated in accordance with the mesh composition and character of the mineral aggregate of the binder and the percentage of material passing a 10 mesh screen to be regulated in accordance with the traffic conditions upon the street or streets to be paved.

WEARING SURFACE

Preparation. The wearing surface shall be composed of sand, filler and asphalt cement of the character elsewhere herein specified and mixed in proper proportions. The sand and the asphalt cement shall be heated separately to such a temperature as will give, after mixing, a surface mixture of the proper temperature for the materials employed. The sand when used must be at a temperature between 250° F. and 375° F. The asphalt cement when used must be at a temperature between 250° F. and 350° F. The filler shall be added to the hot sand in the required proportions and the two thoroughly mixed. The asphalt cement in the proper proportions shall then be added and the mixing continued for at least one minute in a suitable apparatus until a homogeneous mixture is produced in which all the particles are thoroughly coated with asphalt cement. The weights of all materials entering into the composition of the wearing surface shall be verified in the presence of inspectors as often as may be required and the engineer or his representative shall have access to all parts of the plant at any time.

Laying. The surface mixture prepared in the manner above described shall be brought to the street in wagons at a temperature between 230° F. and 350° F. and shall be covered with canvas covers while in transit. The temperature of the surface mixture within these limits shall be regulated according to the temperature of the atmosphere and the working of the mixture, and the character of the materials employed. On reaching the street, it shall at once be dumped on a spot outside of the space on which it is to be spread. It shall then be deposited roughly in place by means of hot shovels, after which it shall be uniformly spread by means of hot iron rakes in such a manner that after having received its final compression by rolling, the finished pavement shall conform to the established grade and have a thickness of not less than . . . inches. Before the surface mixture is placed, all contact surfaces of curbs, manholes, etc., must be well painted with hot asphalt cement. After raking, the surface mixture shall at once be compressed by rolling or tamping, after which a small amount of cement shall be swept over it and it shall then be thoroughly compressed by a steam roller weighing not less than 200 pounds to the inch width of tread, the rolling being continued until a compression is obtained which is satisfactory to the engineer. Such portions of the completed pavement as are defective in finish, compression or composition, or that do not comply in all respects with the requirements of these specifications, shall be taken up, removed and replaced with suitable material, properly laid in accordance with these specifications, at the expense of the contractor. Whenever so ordered by the engineer, a space of 12 inches next the curb shall be coated with hot asphalt cement which shall be ironed into the pavement with hot smoothing irons.

No wearing surface shall be laid when in the opinion of the engineer the weather conditions are unsuitable or unless the binder on which it is to be placed is dry. The finished pavement must be well protected from all traffic by suitable barricades until it is in proper condition for use.

Requirements. The finished pavement shall contain between 9.5 and 12.5 per cent of bitumen soluble in cold carbon disulphide, depending upon its mesh composition and the character of the sand used and the traffic to which it is to be subjected, but in all cases sufficient asphalt cement must be used to properly coat all the particles of the mineral aggregate. It must also contain not less than 10 per cent of mineral matter passing a 200 mesh sieve and not less than a combined total of 25 per cent passing the 200, 100 and 80 mesh sieves. On streets of light traffic, when the engineer has approved the use of a coarser sand or mixture than that specified for general use, the surface mixture must contain not less than 6 per cent of mineral matter passing a 200 mesh sieve and not less than a combined total of 18 per cent passing the 200, 100 and 80 mesh sieves. The maximum amount of 200, 100 and 80 mesh material in the pavement will be regulated according to the kind of sand and asphalt used and the traffic upon the street on which the pavement is to be laid subject to the maximum requirements elsewhere herein specified under sand and filler.

The above limits as to mesh composition and per cent of bitumen are intended to provide for such permissible variations as may be rendered necessary by the raw materials used and by the character of the work to be done. The composition of the wearing surface may be varied within the limits above specified at the discretion of the engineer, depending upon the kind of sand, filler and asphalt used and the traffic conditions upon the street or streets to be paved.

CONDITION AT EXPIRATION OF GUARANTEE

In addition to the proper maintenance of the pavement during the period of guarantee, the contractor shall, at his own expense, just before the expiration of the guarantee period, make such repairs as may be necessary to produce a pavement which shall:

a. Have a contour free from depressions of any kind exceeding three-eighths of an inch in depth as measured between any two points four feet apart on a line conforming substantially to the original contour of the street.

b. Be free from cracks showing disintegration of the surface mixture.

c. Contain no disintegrated surface mixture.

d. Not have been reduced in thickness more than three-eighths of an inch in any part.

e. Have a foundation free from such cracks or defects as will cause disintegration or settling of the pavement or impair its usefulness as a roadway.

REPAIRING

Repairs, except as provided for below, shall in all cases be made by cutting out the defective binder and wearing surface down to the concrete and replacing them by new and freshly prepared binder and wearing surface made and laid in strict accordance with these specifications.

Whenever any defects are caused by the failure of the foundation, the pavement, including such foundation, shall be taken up and relaid with freshly prepared material made and laid in strict accordance with these specifications.

In all cases the surface of the finished repair shall be at the grade of the adjoining pavement and in accordance with the contour of the street.

The surface heater method of repairing may be used only in those cases where the repairs are nor rendered necessary by:

a. Failure of concrete.

b. Failure of the binder.

c. Failure caused by the disintegration of the lower portion of the wearing surface.

Whenever the surface heater method is employed, all defective surface shall be removed before replacing it with new material. In all cases the old surface shall be removed to a depth of not less than one-quarter inch and the new surface must, when compressed, be not less than one-half inch in thickness. The heat shall be applied in such a manner as not to injure the remaining pavement. All burnt and loose material shall at once be completely removed and, while the remaining portion of the old pavement is still warm, shall be replaced by new and freshly prepared wearing surface made and laid in strict accordance with these specifications.

NOTE TO ENGINEERS: *Filler.* As Portland cement is more expensive than lime dust, the specification should distinctly state which kind of filler is desired.

SPECIFICATIONS FOR CREOSOTED WOOD BLOCK PAVEMENT

RECOMMENDED BY COMMITTEE ON STANDARD SPECIFICATIONS

Adopted by the Society November 13, 1912

MATERIALS

TIMBER

The wood to be treated shall be commercial yellow pine, Norway pine or tamarack, only one kind of wood, however, to be used in any one contract. The blocks must be cut from good grade timber; namely, all timber must be sound and free from red heart, well manufactured, saw-butted, all square edge, and shall be free from the following defects: unsound, loose and hollow knots, worm holes and knot holes, through shakes and round shakes that show in the surface. In yellow pine timber the annual rings must not average less than six to the inch measured radially from the heart so as to include the greatest number of rings possible and in no case in any 1 inch of this radius shall there be less than four annual rings. Wherever in any 1 inch of this radius there are less than five annual rings, the cross sectional area of each resin ring shall not be less than 20 per cent of the total cross sectional area of its corresponding annual ring. The blocks must average 80 per cent of heart wood and no one block shall be accepted that contains less than 50 per cent of heart wood.

SIZE OF BLOCKS

The blocks shall be from 5 to 10 inches long, but shall average 8 inches; they shall be . . . . inches in depth. They may be from 3 to 4 inches in width, but all blocks in one street shall be of uniform width. In no case shall the width and depth of the blocks be the same. A variation of $\frac{1}{16}$ inch shall be allowed in the depth and $\frac{1}{8}$ inch in the width of the blocks from that specified.

TREATMENT

The blocks shall be treated with a preservative oil complying with the specifications given below. The exact method of treating the blocks, while not being definitely described, shall comply with the following: the blocks shall not at any time be heated to a temperature higher than 250° Fahrenheit. When treated with oil, the blocks shall be completely immersed therein and the oil shall be forced into the blocks under a sustained pressure of not less than 100 pounds per square inch until the charge as a whole has absorbed an amount of oil equivalent to 20 pounds for each cubic foot of wood contained in that particular charge.

The blocks after treatment must show satisfactory penetration of the preservative oil throughout. All blocks that are in any way defective or that have been badly warped or checked in the process of treating shall be rejected.

OIL

The oil shall be a coal tar product, free from adulteration of any kind whatever, and shall comply with the following requirements:

1. The specific gravity shall be 1.08 to 1.14 at a temperature of 38° C.
2. On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering and Maintenance of Way Association, the distillate shall not exceed 2 per cent up to 150° C. and be not less than 30 per cent nor more than 50 per cent at 315° C; the mean of three determinations to be taken.
3. Not more than 4 per cent of the oil shall be insoluble in hot benzol and chloroform.

The manufacturer of the oil shall permit full and complete inspection and sampling at the factory at which the oil is produced, of all materials, either crude or refined, entering into the manufacture of the finished product, as well as the finished product itself, in order that the material used can be determined to be in accordance with the foregoing requirements. He shall also submit satisfactory proof of the origin of all material entering into the composition of the finished product.

Oil samples taken by the inspector from the treating tank during the process of the work shall at no time show an accumulation of more than 2 per cent of foreign matter, such as sawdust and dirt. Due allowance shall be made for such accumulation of foreign matter by injecting an additional quantity of oil into the block.

INSPECTION

The manufacturer of the blocks shall equip his plant with all the necessary gauges, appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled. He shall allow an authorized representative of the city to inspect all materials and all parts of the plant during the manufacture of the paving block.

After delivery upon the street the blocks shall be subjected to a further inspection and blocks that do not comply in all respects with the specifications shall be rejected and removed from the street by the contractor.

LAYING THE BLOCKS

CUSHION A. SAND

The blocks shall be laid on a sand cushion 1 inch in thickness spread on the concrete foundation. The sand cushion shall be struck by templates to a surface parallel to the grade and contour of the finished pavement in such a manner that when the blocks are set and properly bedded in the sand, the tops shall conform accurately to the finished grade of the pavement. The sand used in this sand cushion shall all pass a quarter inch screen and shall be clean and sharp.

CUSHION B. MORTAR

Upon the concrete foundation shall be spread a layer of mortar 1 inch in thickness and made of one part of Portland cement, of the character provided for use in the foundation, and three parts of sand. Only sufficient water shall be added to this mixture to insure a proper setting of the cement, the intention being to produce a granular mixture which may be raked to the desired grade.

The mortar shall be thoroughly mixed and shall be spread in place on the foundation, immediately in advance of the block laying, to such a thickness that when the blocks are set and properly bedded in the mortar, their tops shall conform accurately to the finished grade of the roadway. The concrete foundation shall be cleaned and swept and shall be thoroughly dampened immediately in advance of placing the mortar bed. The mortar bed shall be struck by templates to a surface parallel to the grade and contour of the finished pavement.

LAYING BLOCKS

Upon the bed thus prepared the blocks shall be carefully set with the fiber of the wood vertical in straight parallel courses at right angles to the curb, except that one row of block shall be placed parallel with the curb and three-quarters of an inch therefrom. The space thus formed between the curb and this row of blocks shall be filled with a bituminous filler having a penetration between 30 and 40 when tested at 77° Fahrenheit. On streets 50 feet or more in width, a second row of blocks parallel to the first row along the curb, and $\frac{3}{4}$ inch therefrom, shall be laid and the space between the two rows filled with a bituminous filler as above, thus forming a double expansion joint.

When deemed advisable by the engineer on streets for heavy traffic the row or rows of blocks parallel with the curb and the expansion joint may be dispensed with.

The blocks shall be laid by setting them loosely together on the cushion coat, but no joint shall be more than $\frac{1}{8}$ inch in width. Nothing but whole blocks shall be used, except in starting a course or in such other cases as the city may direct, and in no case shall less than one-third of a block be used in breaking joints. Closures shall be carefully cut and trimmed by experienced men. The portions of the blocks used for closure must be free from check or other fracture, and the cut end must have a surface perpendicular to the top of the block and cut to the proper angle to give a close tight joint.

After the blocks are placed, they shall be rolled by a small steam roller until the surface becomes smooth and is brought truly to the grade and contour of the finished pavement. When laid on a mortar bed, the rolling shall be completed before the mortar has set and all mortar that has set before the blocks are in place and rolled shall be discarded and replaced by fresh mortar.

After the blocks have been thoroughly rolled, the joints between them shall be filled by sweeping into them fine, clean, dry sand, all of which shall pass a ten mesh sieve.

After inspection by the proper city official, the surface of the wood block pavement shall be covered to a depth of about ½ inch with fine screened sand. This sand is to be left upon the pavement for such time as may be directed by the proper city official, after which it shall be swept up and taken away by the contractor.

NOTE TO ENGINEERS. Blocks may be used either 3½ or 4 inches in depth, according to traffic, and even 3 inches on streets of light traffic. This is to be determined by the engineer in advance and stated in the specification. Either a sand or a mortar cushion may be used, to be determined by the engineer in advance, and the paragraph A or B used accordingly.

BUSINESS PROCEEDINGS

OF THE

Nineteenth Annual Convention of the American Society of Municipal Improvements

TUESDAY, NOVEMBER 12, 1912

MORNING SESSION

The convention was called to order in the Auditorium of the Chamber of Commerce, Dallas, Tex., at eleven o'clock by President E. A. Kingsley.

THE PRESIDENT: Let us stand while Rev. Dr. Truett, pastor of the First Baptist Church of Dallas, offers the invocation.

(*Invocation by Dr. Truett.*)

THE PRESIDENT: I now desire to introduce to you Mayor Holland, who is going to address to us a few words of welcome.

THE MAYOR: Mr. Chairman, ladies and gentlemen: In extending to this convention a few words of welcome this morning, I do not consider it a mere formality, for I appreciate that the delegates to this convention, like myself and other city officials working for municipal improvements, are co-workers; that we are, so as to speak, soldiers of the common good. The city of Dallas feels especially glad because of the fact that such a large percentage of the delegates to this convention are eminent engineers. We have learned the lesson that many, in fact, a majority, of the great problems confronting the cities, especially those of a physical nature, are engineering ones. The world has appreciated that. We here in Texas have learned to appreciate that an ounce of prevention is worth more the the proverbial pound of cure. We appreciate that organzations such as these are doing a great work along that line; that in furnishing for cities abundant and wholesome water, free from typhoid and other disease germs, in disposing of sewage in a scientific and proper manner, in looking after the proper sanitation and drainage of cities, the engineer is doing a work more important for the city than is the health officer. We realize it is much better to prevent these difficulties and misfortunes than to have a big and elaborate health department to take care of them after they once come upon us. We appreciate the fact that today the big problems, especially in America, are the city problems, and America is to be congratulated upon the fact that there exists a society such as this, composed of intelligent and patriotic men who give their valuable time and travel hundreds and perhaps thousands of miles to attend such a convention as this, without profit to themselves, in order to better conditions in American municipalities.

We in Dallas claim, and believe we can say without being accused of immodesty, that while we have not one of the largest, yet we have one of the most progressive cities in the United States. (Applause.) We are carrying on now, for its size, as much important municipal work as any other city in any other state. We are just now completing a water supply system which is large enough for a city more than twice our present size. We have begun work recently on a filtration plant in order that the people may have good water as well as abundant water. Much preliminary work has been done by our city, assisted by a great engineer from New York, on a sewage disposal system. We have done much street paving, and our contractors, I believe, are giving us good work here. That remains, however, for you to say. We are doing considerable work along the line of public building. As an example I point to our new municipal building. We have signed the contract for an uptodate city hospital; I desire to say also in that connection that our city government has realized its duty towards the indigent consumptive, and we shall sign up, in a very short time, a contract for an uptodate tuberculosis hospital.

We appreciate your visit here, and consider it a high honor to entertain you. I know the reception committee will see to it that your stay here is a pleasant one; your program assures that it will be a most instructive one. It will be to us a very beneficial one. I thank you.

The President: Mr. Mayor and citizens of Dallas: It gives us pleasure to hear these words of welcome from you. Knowing your city as some of us do, it gives us double pleasure to have our meeting this year in Dallas. Some of us learned long ago that Dallas was a city of big things, and we have endeavored to make this meeting in your midst one of the big things, not only for us but for Dallas. We are exceedingly gratified at the reception thus far, gratified not only with the reception that your reception committee and your people have given us, but gratified that your weather bureau has favored us also, and we trust that it may for three or four days at least continue with this beautiful Texas autumn weather. We are glad of the things we have seen; we trust we may see more of your city and more of your people. We trust your people may feel that these meetings are open meetings. This is a mutual benefit affair, a sort of coöperative organization. We like to meet with you and have you meet with us. What is good for you is good for us. We trust therefore that your people may feel that all of our meetings are open meetings, all of our meetings are their meetings, and we trust that many of them may meet with us, that we may have the pleasure of their coming here, and that they may benefit by meeting with us.

I now desire to read the President's annual address.

PRESIDENT'S ANNUAL ADDRESS

Gentlemen of the Convention and Visitors.—Three years ago this month we gathered in the southwest for the first time. Today I greet you, in opening our nineteenth session for the second time in the great southwest. This is our first mingling with our Texas brethren and our first glimpse of the metropolis of the great "Lone Star" state.

As I look back upon the eighteen years since the founding of our Society, I am filled with pride at the wonderful growth we have had and at the strength which has come to us as a body. Depending as we do for our membership on the individual rather than municipalities, we are to be congratulated upon the number of older members retained upon our rolls. Especially is this true of the older active members and officials. Few organizations can boast of the circumstance happening near the close of our last meeting and which will bear repeating now. Of the presiding officers chosen during our last ten years, but one who was living was absent from the meeting. Nine men, eight past presidents and the present incumbent, were photographed together at Grand Rapids. Many men were there also who had attended a great many of the previous meetings. I see before me today man after man whose face would be missed were he not present today.

Happenings of this kind speak well for our Society when we consider that many of our active members hold their official positions subject to the turn of the political wheel. Our organization is essentially and altogether a municipal organization, as its name implies. Today the member may be a city engineer or other municipal official. Next week he may be out.

Eighteen years ago a few men conceived the idea of organizing the municipal engineers and authorities into a national organization for the purpose of better acquaintance and fellowship and for the better personal interchange of ideas and broadening of views. For a time the Society's growth was slow. But men like Folwell, Brown, Tillson and the famous Newark bunch do not become easily discouraged. Once each year the Society has met in various parts of the country, following the first convention at Buffalo in 1894. The next meeting was in Cincinnati, then in turn Chicago, Nashville, Washington, Toronto, Canada, Milwaukee, Niagara Falls, Rochester, Indianapolis, St. Louis, Montreal, Canada, and in 1906 Birmingham, Ala. The next year at Detroit only a few of the faithful gathered and after considerable discussion Atlantic City, N. J. was chosen for the 1908 meeting place. Although the Detroit meeting was small, the faithful ones were there and sufficient enthusiam was stirred up to breathe into the Society a new life. The present secretary was selected and began a campaign for increased membership and renewed interest. The next year the results of Mr. Folwell's energy in behalf of the Society bore good fruit. Each succeeding meeting, Little Rock in 1909, Erie in 1910, and Grand Rapids last year have been better. Today we find the Society on a firm basis, going forward with an impetus that will keep it to the front. Its life and its continued healthy growth are now assured beyond any question of doubt. It has become not only a pleasure but an honor to be classed as a member of the American Society of Municipal Improvements. Not only is this true of the active members, but our associate members feel equally as proud of their memberships and your president can conceive of no greater honor to be conferred upon a municipal engineer than that he be selected as president of the American Society of Municipal Improvements. I count it the crowning honor of my municipal work to have been permitted to serve you for a term as your chosen president.

In the little pamphlet gotten out by the secretary, Mr. Folwell says in part, "This Society aims to be of direct advantage to all municipal officials and it is believed that it attains this end to a higher degree than any other national society of any kind." Briefly this expresses the aim of the society. Its object is to do good in promoting, in the first place, fellowship amongst municipal engineers and authorities. Included in the latter term, authorities, we are pleased to class our friends and at times our able assistants, the material men and contractors. We feel that it is good for us to get together occasionally as men rather than as officials and contractors. In these annual meetings we do get together and fellowship one with the other. The fellowship is the cement (Puritan brand), which binds us together and fills the breaks, leaving a minimum of voids. Our Society (with due apologies) is so proportioned as to secure inherent stability, density, freedom from voids, and resistance to displacement. As a mixture when the cement is applied we form a structure with an inherent stability; one in which the largest pieces (the engineer) and smallest pieces (the contractor) are associated with each other indiscriminately, the cement permeating the whole and uniting the various sized particles into one homogeneous body. Those of us who have attended the meetings miss the privilege of nearly a week's association, friendship and fellowship each year when we are, by force of circumstances, not permitted to attend the annual session.

In the second place, the Society aims to be of vast benefit to its members in an educational way, partially through the clearing house conducted by the secretary, and partially through an exchange of ideas at the annual meetings. Each year these meetings are becoming more and more instructive and of greater benefit. Gradually the secretary's clearing house is being taken advantage of more and more and is producing more ready responses and splendid results.

At our annual meetings we have the advantage of listening to papers and talks by men who are experts in their various lines, paving, sewerage, electric lighting, and other branches of municipal work. Probably this is taking advantage of the expert's opinions without adequately reimbursing him in dollars and cents. Yet the speaker believes that these same experts are amply repaid by the friendly spirit and fellowship obtainable at our meetings.

The work now being done by the society is settling down to a systematic basis. We are attempting to carry out this work through various and sundry committees, these committees working more or less during the entire year, and reporting the results at each annual meeting. The committees during 1911 and 1912 have been working on street paving, street traffic, on street lighting, water works and water supply, sewerage, sanitation, garbage disposal and street cleaning, municipal legislation, finance, and municipal data and statistics. In addition to these committees on special lines of work, several years ago there was started a committee on standard specifications, the chairman of which has been Charles Carroll Brown. Mr Brown has with him four past presidents, making five in all forming the standard specification committee. This committee has been at work for several years not only through our own society but has been working in a large measure with the association formed three years ago at Chicago for the purpose of standardizing paving specifications. Our committee is a little broader in its scope than the latter organization, in that it does not confine itself altogether to paving.

Mr. Brown's committee has selected six sub-committees from various sections of the country and divided these sub-committees into those on wood block paving, brick, bituminous, concrete, and asphalt paving and sewers. Good work has been done in the past by these various committees and your president is confident that this year's meeting will prove no exception to the past meetings.

Our specifications are now referred to in a great many cities and many material men and contractors can be found who are offering material and work according to the "specifications of the American Society of Municipal Improvements."

At this meeting of our society we shall take up the question of amalgamation with the Association for Standardizing Paving Specifications. This question has been before the Executive Committee a number of times and at the last meeting of the association at New Orleans the latter organization was instructed to appoint a committee to confer with out society. Our past president and their past president, Mr. Tillson, was appointed chairman, and your president, vice-chairman of this committee. Mr. Tillson has worked out a plan of amalgamation which will be submitted to our society at this meeting. Your president desires to commend heartily this plan and urge its adoption. It has the hearty approval of Captain Hardee of New Orleans, the president of the Association for Standardizing Paving Specifications. If adopted by our Society we feel sure of its adoption by the Association for Standardizing Paving Specifications at Pittsburgh in January. I would recommend that a committee be appointed to confer with a like committee at Pittsburgh to attempt to effect a consolidation of the two great municipal associations.

Probably the *greatest thing* before us at the present time is the question of standardizing as far as possible our specifications and work. As Mr. Tillson said two years ago in New York City regarding paving, "We have been laying pavement in this country for over three hundred years and not a mile of standard pavement existed thirty-five years ago. I feel also that this work (standardizing) is not complete. I feel that we have not arrived at the best pavement. We have only taken one step towards the solution of the problem. We have still to adapt to the street the best material that it needs most. I want to say, gentlemen, that in this Borough of Manhattan one of the very hardest things to do is not only to get the best pavement, but to have the best pavement in the right place."

Gentlemen of the convention, these words have often been recalled to your president. Truly, indeed, has Mr. Tillson spoken. Not only are we oft times at our wits end which of several pavements proposed is the best, but which for the conditions would be best to use. The question of standardizing has only just begun and it must seem that there is nothing more important before our Society than the all important question of standardizing not only materials, workmanship, and methods, but standardizing for results obtainable under every condition.

In opening this, our nineteenth meeting, I desire to thank most heartily those who have cordially welcomed us to this beautiful city and the fair state of Texas and to commend Mr. Dalton and his associates for their untiring efforts in endeavoring to make our stay in Dallas a pleasure and our meeting a success. Mr. Dalton informs me that a great deal of credit is due to the efforts of Mr. Preston, the city engineer, and to Mr. Johnson, the president of the Texas Bitulithic Company, who have both labored with Mr. Dalton and spent time and money to give us a good time. I wish to thank the various committee chairmen and members who have so kindly consented to aid me in various capacities during the present year and to congratulate the Society upon the results attained. These remarks would not be complete without a reference to the attention given the work by our two municipal journals, the editors of both of which have exerted themselves in behalf of the Society and its interests. Neither would I dare close without commending to you the untiring efforts of our secretary, Mr. Folwell. Without Mr. Folwell, our Society would be lacking considerable, and a great deal of our growth is directly traceable to the personal efforts of our noble secretary.

Members of the association, visitors to Dallas and to our meeting, and Dallas friends, our nineteenth annual convention is now in session and you are earnestly requested and urged to meet with us at one and all sessions. We ask you to enjoy all of our privileges with us that we may all have a good time and a good meeting together. I thank you.

THE PRESIDENT: The next order of business will be the report of the secretary.

REPORT OF THE SECRETARY

The Society continues to grow in membership, thanks to the efforts of a number of our members; but these efforts are confined to too few, and the secretary again urges that every member make an effort during the year to bring in at least one or two. He believes that this will be a benefit to those who join and secure the advantages of the Society; and also to the present members, since these advantages increase to all as the membership increases. Since the report for 1910–1911 was presented, 91 members have been admitted, 15 during the Grand Rapids convention and 76 during the year. Three were transferred from active to associate and one from active to affiliated. Fifteen have resigned and 29 were dropped for non-payment of dues. Two members have died, Atwell Thompson, city engineer of Jackson, Tenn., and Ulrich E. Taubenheim, manager of Water Works of Archangel, Russia. The membership at present comprises 327 active members, 73 associate and one affiliated.

The sale of *Proceedings* has been even greater than last year, $144.50 having been received from this. The other receipts were as follows: Advertisements in *Proceedings*, $354; sale of specification pamphlets, $33.30; sale of certificates and buttons $7.50; balance from Exhibit Committee, $68.90, and dues $1714.

The expenses may be classified as follows: Publishing and distributing *Proceedings*, $957; convention expenses, $265.08; publicity, $217.65; postage, $121.53; office assistants, $120.80; other office expenses, $200.83; standard form investigation, $78.50; clearing house, $9.90; engrossing membership certificates, $4.25. The total receipts were $2,322.20; the total expenditures $2,289.69; leaving a balance in the treasury of $1,209.03.

The following is the list of members admitted since the previous convention:

MEMBERS ADMITTED DURING THE YEAR 1911–1912

(Includes also those admitted during the remaining days of the convention)

Active members

Aldridge, William, Chief Computor & Estimator, 333 McGee Street, Winnipeg, Man., Canada.
Ashley, Charles S., Mayor, New Bedford, Mass.
Astley, John W., Engineer of Construction, 714 Broadway, Winnipeg, Man., Canada.

Baltzer, August, City Engineer, 783 Market Street, Kenosha, Wis.
Bean, W. Irving, City Engineer, Terrell, Tex.
Blanchard, A. C. D., City Engineer, Lethbridge, Alta., Canada.
Bradshaw, H. J., City Engineer, Abilene, Tex.
Bull, Irving C., Chemist, Care of Bull & Roberts, 100 Maiden Lane, N. Y. City.

Crayton, G. A., City Engineer, Lima, O.
Crook, J. W., City Engineer, 1704 Lamar Ave., Paris, Tex.

Danford, W. P., City Engineer, Durant, Okla.
Dickey, A. T., City Engineer, Galveston, Tex.
Douthitt, M. J., City Engineer, City Hall, Waukegan, Ill.
Drowne, Henry B., Principal Assistant Professor Highway Engineering, Columbia University, N. Y. City

English, Jos. E., Assistant Engineer Street Department, Trenton, N. J.

Fetherston, John Turney, Engineer of Street Cleaning, New Brighton, N. Y.
Fewell, J. H., Engineer and Superintendent, Jackson, Miss.
Flenniken, John W., Commissioner Streets and Public Improvement, Knoxville, Tenn.

Gardiner, W. H. R., Superintendent Public Works, Calgary, Alta., Canada
Gillespie, Richard H., Chief Engineer Sewers and Highways, Bronx, N. Y. City
Goodfellow, J. J., City Engineer, San Angelo, Tex.

Hammett, W. S., Mgr. Pitts. Testing Laboratory, Dallas, Texas
Hawley, John Blackstock, Hoxie Building, Forth Worth, Texas.
Hoff, Carl P., Assistant City Engineer, St. Joseph, Mo.
Hottel, Howard C., City Chemist, City Hall, Trenton, N. J.
Hubbard, George W., Superintendent Water Works, Elberton, Ga.
Hudson, Leo, Consulting Engineer, McKeesport, Pa.
Hughes, T. C., City Engineer, Tulsa, Okla.

Kirkpatrick, Walter G., City Engineer, Birmingham, Ala.
Klausman, Henry W., City Civil Engineer, City Hall, Indianapolis, Ind.
Klodt, B. G., Designing and Constructing Engineer, San Antonio, Tex.

Lea, Lucian D., City Engineer, Lead, S. D.
Lenderink, Andrew, City Engineer, Kalamazoo, Mich.
Lewis, J. E., General Superintendent of Fred A. Jones Company, Dallas Tex.
Lovewell, Maurice N., Assistant Engineer South Park Commissioners, Chicago, Ill.
Lowry, J. W., Superintendent Water and Electric Light Plant, Grenada, Miss.

Mesiroff, J. A., City Engineer, City Hall, Milwaukee, Wis.
Mitchell, J. W., Mayor, City Hall, Calgary, Alta.
Murphy, M. D., Director Street and Sewer Department, Wilmington, Del.
Myers, Geo., City Engineer, Ft. Smith, Ark.
McCabe, John C., City Boiler Inspector, City Hall, Detroit, Mich.

Osbourne, E. M., Superintendent Light and Water Commission, Talladega, Ala.

Parsons, Maurice G., Engineer with Harbor Commissioners, Los Angeles, Cal.
Payton, Lyle, City Civil Engineer, Moline, Ill.
Perry, Charles E., Canajoharie, N. Y.
Petersen, E. F., Consulting Engineer, Muskogee, Okla.
Pierce, John Irvin, City Engineer, Jackson, Miss.
Pillet, Frederick Fischer, City Engineer, Wilmington, N. C.

Reed, Merle H., City Engineer, Fort Smith, Ark.
Rich, D. H., Water and Light Commissioner, Red Cloud, Neb.
Rudolph, Charles A., Street and Sewer Director, Wilmington, Del.

Sharp, John C., Engineer of Sewers, Portland, Ore.
Sloan, M. S., Birmingham, Ala.
Sparks, George W., President Street and Sewer Board, Wilmington, Del.
Spencer, George C., Superintendent Water and Light and City Engineer, Marianna, Fla.
Stallings, Robert, Civil Engineer, Little Rock, Ark.
Stevenson, John D., Assistant Engineer Bureau of Construction, Pittsburgh, Pa.

Thomas, J. Fred, Borough Engineer, Farrell, Pa.
Thum, William, Mayor, Pasadena, Cal.

Van Zuben, Frank J., Acting City Engineer, Fort Worth, Tex.

Waite, H. M., Chief Engineer, Cincinnati, O.
Welborn, M. C., Chief Engineer of Sewers, Austin, Texas.
Whitman, Ezra B., Water Engineer, Baltimore, Md.
Whyman, R. O., Soliciting Engineer, O'Neill Engineering Company, Dallas, Tex.
Wills, Joe. B., Chief Sanitary Inspector, City Hall, Dallas, Tex.
Wilson, James, Superintendent Water Works, Calgary, Alta.

A total of 67 active members

Affiliated members

Norman, W. H., Constructing Engineer, Dallas, Texas.

Associate members

Blackmer & Post Pipe Company, St. Louis, Mo.
Briddel, York, General Superintendent Graves Matthews Paving Company, Birmingham, Ala.
Burns, Bob, 3120 San Jacinto, Dallas, Tex.

Cullman, H. F., Houston, Tex.
Cutter, Frank G., Representative Warren Brothers, 1349 Otis Building, Chicago, Ill.
Curless, Theo. A., Cement Engineer, Seattle, Wash.

Doane, S. E., Chief Engineer, 4411 Hough Ave,, Cleveland, O.
Dodge, C. P., Mfr. Municipal supplies, Texas Company, Houston, Tex.

Foote Concrete Machinery Company, H. B. Franklin, Vice-President, 108 S. La Salle St., Chicago
Fuller, Claude E., Superintendent Buffalo Brick Company, Buffalo, Kan.

Greene, S. G., Superintending Engineer El Paso Gas and Electric Company, 4010 Simpson St., Dallas, Tex.
Griffith, O. J., Treasurer and General Superintendent Little Rock Railway and Electric Company., Little Rock, Ark.

Horton, D. C., Jacksboro, Texas

Kemp, L. W., Salesman, Texas Company., 216 N. Haskill Ave., Dallas, Tex.

Peebles Paving Brick Company, Sales Mgr., Portsmouth, O

Rudd, A. E., Secretary and Treasurer, General Construction Company, 143 Cambridge St., Guelph, Ont. Canada
Stubbs, R. C., 1418 Praetorian Building, Dallas, Tex.

Thurston, Geo. W., Secretary Western Paving Brick Manufacturers' Association, 500 Ridge Building, Kansas City, Mo.

Whitley, Frank, Representative Ockander Brothers, Hillsboro, Tex.
Wright, G. W., President Okla. Glazed Cement Pipe Company, Tulsa, Okla.

A total of 20 associate members.

THE SECRETARY: The *Proceedings* of the society are in much greater demand by colleges, universities and places of that sort than formerly, which shows that the knowledge that is brought here is disseminated much more over the country than has heretofore been the case. I think this is one of the most encouraging features of our work.

THE PRESIDENT: The next will be the treasurer's report.

TREASURER'S REPORT

NEWARK, N. J., November 1, 1912.

Receipts

Balance on hand September 26, 1911	$1,176.52	
October 10, 1911, A. P. Folwell	250.00	
November 1, 1911, A. P. Folwell	275.95	
February 9, 1912, A. P. Folwell	400.00	
February 28, 1912, A. P. Folwell	260.00	
May 6, 1912, A. P. Folwell	309.80	
August 17, 1912, A. P. Folwell	204.00	
October 31, 1912, A. P. Folwell	622.45	
		$3,498.72

Disbursements

October 9, 1911, S. E. Tate Printing Co., illustrations	$ 42.32
October 9, 1911, Federal Printing Co., advance papers	6.50
October 10, 1911, Frank F. Lisiecki, programs	28.75
October 10, 1911, A. P. Folwell, convention expenses	83.51
October 16, 1911, Central Law Reporting Co., reporting convention	75.00
November 6, 1911, National Surety Company, treasurer's bond	8.42
November 6, 1911, A. P. Folwell, office expenses	37.45
November 9, 1911, Frank F. Lisiecki, stationery	19.30
November 9, 1911, Moss Photo Engraving Co., cuts for proceedings	42.02
December 5, 1911, A. P. Folwell, office expenses	75.21
December 5, 1911, Merrit & Haufling printing pamphlets, etc	61.54
December 5, 1911, Downing Letter Co., duplicate letters	3.00
December 5, 1911, Frank F. Lisiecki, stationery	40.40
December 5, 1911, Moss Photo Engraving Co., cuts for proceedings	6.50
January 20, 1912, Frank F. Lisiecki, stationery	46.85
January 20, 1912, A. P. Folwell, municipal data investigation	115.64
February 14, 1912, Frank F. Lisiecki, stationery	7.75
February 14, 1912, A. P. Folwell, office expenses	69,.50
March 5, 1912, S. E. Tate Printing Co., proceedings	867.62
May 10, 1912, A. P. Folwell, office expenses	39.95

July 30, 1912, Frank F. Lisiecki, stationery	$7.00	
October 22, 1912, A. P. Folwell, salary and office expenses	382.41	
November 1, 1912, F. E. Puffer, services standard form investigation	25.00	
November 1, 1912, Downing Letter Co., circular letters	29.50	
November 1, 1912, F. F. Lisiecki, stationery,	139.00	
November 1, 1912, A. P. Folwell, office expenses	29.55	
Total disbursements		$2,289.69
Balance November 1, 1912		1,209.03
		$3,498.72

The following table, showing the receipts, disbursements and balance in the treasury for the past three years is interesting as showing the financial growth of the Society (previous year's balance omitted in "Receipts" column).

Year	Receipts	Disbursements	Balance
1909–1910	$1,631.40	$1,599.85	$ 698.61
1910–1911	2,148.95	1,671.04	1,176.52
1911–1912	2,322.20	2,289.69	1,209.03

Respectfully submitted,

EDWARD S. RANKIN,
Treasurer.

THE PRESIDENT: I will now ask the finance committee to read its report.

REPORT OF THE FINANCE COMMITTEE

Your Finance Committee have examined the financial accounts of Secretary A. P. Folwell and Treasurer Edward S. Rankin and have found them in agreement and correct as stated. They show gross receipts for the society year ending October 31, 1912, of $2322.20, exclusive of balance of $1176.52 in hand at the beginning of the year. They show disbursements of $2289.69, leaving a surplus for the year of $32.51, making a total balance in hand of $1209.03 and no debts to pay.

Louis L. Tribus, *Chairman,*
Arthur R. Denman,
W. J. Parkes.

The President: Considering the immense amount of work done and paid for by the secretary during the past year, we should be exceedingly proud, not only because of the growth of the society in membership, but because of its financial standing and strength. We will now have the report of the executive committee.

The Secretary: The executive committee met this morning according to program, and among other business accepted the application for membership of thirty-five new members. Other matters were considered. The president has already referred to the proposed amalgamation of this society and the Association for Standardizing Paving Specifications. There are some proposed amendments to the constitution which have been recommended by the Executive Committee, and these amendments are as follows:

Add to Sec. 2 of Art. II, the second paragraph: "Election shall take effect upon the payment of the dues to the end of the current year."

Add to Sec. 1 of Art. III: "The executive committee may remit the dues of a member in whole or in part."

Add to Sec. 4 of Art. IV: "The secretary of the society shall be the chairman of the Committee on Convention Papers, and may name two or more additional members of said committee."

Mr. Parkes. I move that those amendments be made a special order of business for eleven o'clock tomorrow morning.

(*Motion seconded by Mr. Howell and carried.*)

The Secretary: Continuing the report of the executive committee, there came before it a communication from a special committee of the Association for Standardizing Paving Specifications, which communication was as follows:

NEW YORK, October 28, 1912

THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS,

Gentlemen:

At the last meeting of the Organization for Standardizing Paving Specifications, held in New Orleans in January, 1912, the undersigned were appointed a committee to consider the matter of the amalgamation of the above organization with the American Society of Municipal Improvements, provided a satisfactory scheme of consolidation could be worked out.

This committee, after carefully considering the subject, has decided that it is advisable that the amalgamation should take place. Both of these organizations are made up of city officials and many officials belong to both organizations. It does not seem proper from any standpoint that two sets of city officials should be working along the same lines for the same objects, but producing in many cases different results. The Organization for Standardizing Paving Specifications was organized for the one purpose only, while the American Society of Municipal Improvements, as its name suggests, deals with everything that relates to a city's welfare. It is also an older organization and has a larger membership; consequently it seems logical, if the two societies are merged, that the younger and smaller should join the older and larger.

The committee therefore feels that it is ready to recommend to its Organization that it merge with the American Society of Municipal Improvements on the following conditions:

1. That, if such amalgamation do take place, the members of the Organization shall be received into the American Society of Municipal Improvements and their dues fixed at $3.00 per year as long as funds remain in the treasury of the Organization to pay said dues; the Organization itself to specify to the Society just what individuals shall be received under the above terms.

2. Members of the Organization who are at present members of the Society to be received upon the same basis as those who are not members.

3. The Organization has standing committees on the different kinds of pavements. Should the amalgamation take place, it will be understood that the members of these committees shall form a part of corresponding committees in the society where such exist; and, where not, that they be independent committees. These joint committees shall report at the next meeting of the American Society of Municipal Improvements on standard specifications for the different pavements, and thereafter all committees shall be appointed as regular committees of the Society.

Should the American Society of Municipal Improvements agree to the foregoing propositions, the undersigned committee is prepared to recommend positive action upon the same at the next meeting of the Organization for Standardizing Paving Specifications, which is to be held in February or March of 1913.

The committee would ask, therefore, that the matter be taken up at the Dallas meeting of the society and definitely acted upon so that final action can be taken by the Organization at its Pittsburgh meeting.

Respectfully,

W. J. HARDEE, *chairman ex-officio,*
GEO. W. TILLSON, *active chairman,*
E. A. KINGSLEY, *vice-chairman,*
W. F. MCKENNA, *consulting engineer,*
C. E. P. BABCOCK.

THE PRESIDENT: If there is no objection, we will set this as a part of the special order of business for eleven o'clock tomorrow morning, as it is very closely connected with at least one of the amendments.

The next is the report of special committees.

THE SECRETARY: The society last year instructed the secretary to undertake a certain work in connection with the standardizing of forms for the use of municipal departments, but as he has made the result of his efforts the subject of a paper for this evening, with the consent of the society he will postpone making that report until this evening.

MR. PARKES: Two very valued associate members of the society, C. M. Cottam and J. D. Waters of the Barrett Manufacturing Company, have been called away by the death of Mr. Marcus of their firm. I therefore move that the secretary be instructed in proper form to tender to these two gentlemen the condolence and sympathy of this society.

(*Motion seconded by Mr. Fisher and carried.*)

THE SECRETARY: In line with the motion just made, perhaps it would be well to have another resolution acted upon. This society learns that Mr. Charles C. Brown is unable to be here because of illness in his family. Mr. Brown is chairman of the general committee on standard specifications, and the excellent results of last year are largely due to his efforts. While I hope the work of the various sub-committees this year will not suffer because of Mr. Brown's absence, I know we shall miss him greatly in connection with the work of this convention. He has lost a daughter during the year, and at present his wife is very sick, and that prevents his attendance here.

Mr. Giddings: I move that we send to Mr. Brown a message of sympathy and condolence, expressing our regret at his inability to be present with us.

(*Seconded by Mr. Howell and carried.*)

The Secretary: I have an invitation from Mr. Samuel H. Hodgden, president of the League of Missouri Municipalities, to this society, to attend their meeting in St. Louis, December 16, 17 and 18.

One of our members, active in committee work, chairman of the committee on parks this year, Mr. Solotaroff, I am informed has been too ill during the past few months to attend to any work for the society, and I know we regret very much that he has been so afflicted.

I have also received from the gentleman who was at the time of writing the acting city engineer of Jackson, Tennessee, a communication as to the death of Mr. Atwell Thompson.

> Mr. Atwell Thompson died at his home at 6.30 p.m. January 30, 1912, after three weeks of sickness from a complication of diseases. He was forty-seven years of age; a graduate of the Royal University of Ireland at Dublin also a graduate of other English universities. At the time of his death he was city engineer of this city, also vice-president of the Memphis to Bristol Highway and consulting engineer for the Western Division of the same highway. He was in times past chief engineer and in charge of Chicamauga National Military Park near Chattanooga, Tenn., National Military Park. He held the office of major of engineers in the United States army while on these parks. He was a Mason, was considered one of the leading engineers in the south.
>
> J. P. McMillin.
> *Assistant City Engineer.*

I have also received notification of the death of our only Russian member, Mr. Ulrich Taubenheim, of Archangel, Russia. He died some time ago, but the details I have no information about.

We also have a letter from Mr. Frank A. Wolf, of the Bureau of Standards of Washington, D. C. This letter is as follows:

BUREAU OF STANDARDS,
WASHINGTON, D. C. October 17, 1912.

MR. A. PRESCOTT FOLWELL, Secretary
American Society of Municipal Improvements,
50 Union Square, New York, N. Y.

Dear Sir:

I beg to submit for the consideration of your Society a proposal having for its object the realization of a comprehensive coöperative social economy exhibit at the San Francisco Exposition in 1915. It embodies as one of its features a municipal section, to illustrate all the lines of municipal activity, making it, therefore, of special interest to your organization.

The aim and scope of the project were set forth in an address, delivered at the Los Angeles meeting of the National Municipal League and published in a slightly abbreviated form in the August issue of the San Francisco "Improver," a copy of which is being sent under separate cover.

The plan outlined is intended to suggest one method of treatment. The classification submitted, and the list of topics to be illustrated, are also to be considered as tentative.

As it appeared to me, the possibilities of the proposal lie not only in the exhibit itself, and in the topical reports, for the publication of which the federal government should be urged to provide funds, but more especially in securing through its means, permanent federal recognition of the many problems with which organized society is confronted and continuing federal assistance in their solution. Above all, the proposal can be made the means of developing a great coöperative movement, binding together nations, states, municipalities, civic and sociological organizations and individuals, all working for the promotion of general welfare.

Since its inception the general plan has received the endorsement of the National Conference on City Planning and the commendation of the Council of the National Municipal League and of the executive board of the American Civic Association as also the hearty approval of numerous members of these organizations, Senators and Representatives in Congress, bureau chiefs and other officials in the government service, municipal officials, individuals interested in civic and sociological matters, and representatives of other interests to whom the proposal has been submitted. It has also met with the utmost encouragement from the Panama-Pacific Exposition Company which has practically committed itself to such an exhibit. The success would depend in a large measure upon the assurance of federal endorsement and appropriate federal participation, through which it would be possible to develop coöperation.

Should the project appear worthy of consideration, I would respectfully suggest that it be submitted to your organization for endorsement, and if such action should be taken, I would further suggest that a copy of the resolutions adopted be sent to Hon. Charles Nagel, Secretary of Commerce and Labor, since the Exposition Company has taken the stand that the federal participation called for should be taken on the initiative of the federal government.

Very respectfully,
FRANK A. WOLFF.

They want to have the national government enter into the project, and to secure the assistance and coöperation of the national departments, with the idea of obtaining an exhibit and conference on municipal topics at the San Francisco Exposition. Their idea is to have the display classified, not by cities but by topics, to have one department for engineering, another sociological, etc. They want us to endorse the project, and send a formal request to the Bureau of Labor asking the government to enter into the project.

THE PRESIDENT: I would suggest that the matter be turned over to the secretary for such action as he may deem best for the best interests of the Society.

MR. CHRIST: I move that that be done.
(*Motion seconded by Mr. Giddings and carried.*)

THE SECRETARY: There is another matter that may be interesting, and that is, a sort of contest on city planning. The National Conference on City Planning has decided to endeavor to develop an interest and to obtain information on that subject by establishing a contest. Their idea is to select a definite area or an imaginary one, I am not sure which, and submit a topographic map of that to planners, to prepare for that area a city plan. And they use the term "city planning" in a broad sense, not simply architecture, but also engineering. The contestants are to work out ideal conditions for a city on the piece of topography submitted. Then the plans will be compared. No prizes are offered. Communications from the secretary of that organization describing this further may be examined at the secretary's desk.

THE PRESIDENT: I would suggest now that the society name five members to act as a nominating committee, and five members to act as committee on next place of meeting.

The following gentlemen were nominated and elected as the Nominating Committee: Messrs. Fisher, Parkes, Giddings, Dow, Nicholson.

The following were nominated and elected as Committee on Next Place of Meeting: Messrs. Howell, Dalton, Macallum, Craig and Colby.

(*The convention then adjourned to 8 p.m.*)

EVENING SESSION

Meeting called to order by the President at 8.15 o'clock.

THE PRESIDENT: The report of the committee on garbage disposal and street cleaning will have to be omitted, as the chairman is not here. Mr. Solotaroff has been ill, and we shall have to pass his report. I will ask the secretary to read Mr. Nicholson's report. Mr. Nicholson is busy with his committee.

(*The Secretary reads report of Committee on Municipal Legislation and Finance.*)

THE PRESIDENT: I think that was the idea Mr. Nicholson intended to bring out in the paper, as to those few cities that had adopted that plan. The proposition of Staunton, Virginia, and these other cities mentioned is very similar to the Canadian plan.

The next is a paper by Mr. Tribus, commissioner of public works, Richmond Borough, New York City, on "The City Economic." Mr. Tribus is not here and I will ask the secretary to read his paper.

(*The Secretary reads Mr. Tribus' paper.*)

THE PRESIDENT. We will next have the report of the committee on municipal data and statistics, by Mr. Hallock, chairman.

(*Mr. Hallock reads report.*)

MR. HALLOCK: I would urge upon the society at this convention to either take up this matter seriously and go into it with more vigor than we have displayed thus far, or drop it, because the appointment of a committee of three year after year has produced no results. I think the subject is of such importance that if we are to do anything, it should be done immediately.

THE PRESIDENT: Perhaps we had better at this time hear Mr. Folwell's paper.

(*Mr. Folwell reads his paper.*)

MR. PARKES: I do not agree with the secretary that our usefulness along the line of paving specifications will die in a few years. We haven't begun to take up the matters of physical improvements for which we must make specifications. I do know that our specifications are recognized more than those of any other society. I believe we have a new field of usefulness before us in the creation of uniform blanks to be known as the uniform accounting and reporting blanks of the American Society of Municipal Improvements. I move you that a committee to be composed of Mr. Folwell, Mr. Hallock and Mr. Nicholson be appointed to report at this convention on the committees that would be necessary in order to carry this idea into effect.

I think the secretary is correct in his idea that we should put into effect a system of uniform blanks for accounting purposes, to be known as the American Society of Municipal Improvements forms. In order to do that, it should be carefully considered and not be done hurriedly on the floor. This committee would consider this matter and report back to this body during its sessions here in Dallas as to what committees and sub-committees should be appointed to put this into effect and carry out the idea, to prepare standard forms and blanks in connection with municipal data and statistics.

MR. RANKIN: I second that. All three of these gentlemen have given sufficient time to this already so that they can make the report without undue loss of time.

(*Motion duly carried.*)

MR. INGRAM: These committees, when they prepare these forms, to see if their city is getting value received on contract work, should not only take into consideration the cost of different items such as sand, filler and brick and things of that sort, but should also have a column prepared for freights, because very often it is unfair to compare the cost at one city with that at another when the freights on raw material are different. There are many things to take into consideration.

The President: The term "freight" would also carry with it royalties.

Mr. Ingram: Yes, sir; and also engineering features.

Mr. Macallum: This is a big thing. While you can get standard forms to a certain degree in paving, the cost of sand is very different from the cost of rock. Then pumping is different. All these details tend to complicate any affair so that you may not be able to compare it. Take waterworks; the cost of coal you can get all right, but the grade of coal and the firing have a bearing. A good fireman or a poor one will make a difference. Is there sand in the water? If so, that will have effect on pipes and pumps. The age of the pumps and the kind of pumps make a difference. You may have different degrees of slip. You can determine that closely if you have the right kind of engine man, but many men cannot determine slip. Then, turbine engines are coming in, and that makes another difference, and you have to compare the turbine engine with the other kinds.

The President: The committee was appointed to look into those things and recommend back if the things were feasible, and in what way feasible.

Mr. Macallum: There are many details. Whether the water mains have a line pressure of 100 feet or a pressure of 300 feet makes a big difference.

The Secretary: When we started to provide the standard specifications, it was said we could not because there were different grades of sand in different parts of the country, because of differences in temperature, etc., between say Jacksonville and Detroit. It is possible this committee won't succeed, but I believe we should try.

The President: If there is no objection, we will now adjourn until nine o'clock tomorrow morning.

WEDNESDAY, NOVEMBER 13

MORNING SESSION

Convention called to order by the President at 9.15 o'clock.

The President: The first thing this morning will be the report of the Committee on Sewerage and Sanitation, by Mr. Macallum, Chairman, and also a paper by him on "Pollution of Surface Waters."

Mr. Macallum: You will see that we have been fortunate in getting a number of papers on this topic.

(*Mr. Macallum reads report and paper.*)

Mr. Fisher: I would suggest the other papers on this subject be read before we take up the discussion.

The President: I will ask the secretary to read Mr. Ogden's paper on "The Status of the Imhoff Tank."

(*The Secretary reads Mr. Ogden's paper.*)

(*Vice-President Briggs assumes chair.*)

The Vice President: We will next have the paper of Mr. Dalton. He is compelled to be absent this morning and I will ask the secretary to read it.

(*The Secretary reads Mr. Dalton's paper.*)

The Vice President: I will now call upon Mr. Anderson to read his paper.

Mr. Anderson. I will have to beg the indulgence of the society for the first part of the paper, which might not be considered appropriate to the question before us.

(*Mr. Anderson reads his paper.*)

(*The President resumes chair.*)

The President: We will now take up the matter that was made a special order of business for eleven o'clock this morning; that is, the report made to the society with reference to the adoption of the suggestion of amalgamation with the Association for Standardizing Paving Specifications. It has been adopted unanimously by the committee from that society and recommended by your executive committee for adoption by this society.

Mr. Hallock: With due respect to the members of our executive committee and the committee from the other organization, I think there are some points in that report that should be cleared up for the benefit of the members who are not thoroughly in touch with it. It says that the members shall be admitted into this society on the payment of $3 annual dues as long as the funds of the organization last. That may be a small or it may be a great item. If the funds of the organization are large enough to permit the members of the organization who are at the same time members of the society to reduce their dues $2 a year for ten years, it would mean quite an item; if the funds of the organization are limited, and it means the payment of one or two years dues at that rate, it doesn't matter much. The majority of the members of the organization are already members of this society.

Another point I do not get clearly fixed is, why an organization much younger than our society, although it has done good work, should come to us with this proposition of amalgamation, and should dictate the appointment of the members to our committees.

The President: Being a member of both organizations I would state that there is not the slightest likelihood of the funds available being sufficient to pay the dues for ten or five or three or probably two years. The meeting at Pittsburgh will in a large measure deplete the treasury of the association for Standardizing Paving Specifications. So there is not the slighest reason to fear anything from that source. As to the possibility of their dominating our meetings or committees, we should consider that. There is a possibility of such a thing happening, although not a probability. When the matter is sifted down, credit can be given to Mr. Christ and Mr. Tillson and a few other members of this society who are members of the younger society, for effecting this amalgamation. It does not come from the organization direct, or, while it comes from them, it has been promoted indirectly by the members and the older and active members of our own organization, and I believe we are largely responsible for this report here today.

Mr. Parkes: How many members has the Society for Standardizing Paving Specifications?

The President: The membership is not individual; it is by cities. I do not know how many cities are members.

Mr. Christ: In the last meeting, about twenty-one were represented, but I think there are between forty and fifty cities.

Mr. Parkes: How many of those individuals are members of this society?

The President: About 65 per cent, maybe more.

Mr. Parkes: By accepting this proposition we will gain from fourteen to twenty new members.

The President: I do not believe we shall gain more than twenty-five new members.

Mr. Parkes: None of whom have paid from their own pockets anything for membership in that organization. I agree with Mr. Hallock with reference to those two things. I see no reason whatever why any man who has the full privileges of an active member of this society should not pay as much as his brother. But if we have to extend charity, do not let us be niggardly. Let us give it to them for nothing, for say two or three years. There is no absolute necessity for our extending the olive branch. They must come to us. They have about run to the end of their work. They were organized for a specific purpose, and when they complete it, they must quit. I want them in. I quite agree, however, with Mr. Hallock. That proposition says that where we have a committee appointed for preparing specifications on some similar topic, that the membership will amalgamate to form a special committee, and where we have no committee and they have one, they say that becomes the committee of this society. I think we should be permitted to add as many members as they have on the committee.

The Secretary: In a way I agree with all that has been said. I had never studied the entire proposition until I came here, but this matter of reduced fees was telephoned me in New York, and I asked why they wanted some of the dues remitted, saying "If your members want to come in under that proposition, I think we can extend it to you, but I should think some of them would object to the appearance of a bargain like that." I still say that if the members of that society want to ask us to let them in on those terms, we can let them come in. Our finances are in good condition, and there has never been a year when the treasurer has not reported a surplus in the treasury, and that surplus has been increasing. I think the financial side, therefore, can be dropped. Most of our members that I have talked with are also members of the other society, and most of them objected to having their dues reduced. With reference to the committees, they do not say how large their committees are, but if we want to, we can add other members to our committees. Our constitution allows for as many as we please. We can find out how many they are going to send, and appoint sufficient additional members. After the first year, the appointment of the committees will be regular.

The President: I think our standing committees cover the same ground as theirs.

Mr. Rankin: Then there will be no new committees. Will the three dollars dues, if we accept this proposition, cover one member from each city or all the members? Newark has the largest membership of any one city in this society. Will one member pay three dollars and the rest five, or will all pay three?

Mr. Craig: I see no reason why the members of the other organization should be admitted at reduced rates, but I believe the almagamation such as proposed here is very desirable. I am a member of both organizations and feel I can speak from experience. I remember the first meeting of that organization. Your chairman on paving specifications, Mr. C. C. Brown, came to our meeting, and in our discussion at that time the question came up as to whether we should have another organization. Mr. Brown was told that this organization was gotten together for a purpose, and that was the perfection of paving specifications, and I believe if you will refer back to your own records, you will find that very little work was done at that time covering detailed paving specifications. You had certain committees, but very little was done until the next meeting. Mr. Brown said to our committee that this was a good thing and couldn't help but do us all good. He said, "Perhaps we have been a little negligent in not getting busy along this line, and it will wake us up." Last year I was asked by Mr. Brown to meet with your association at Grand Rapids. That was the first meeting I had attended, and at that time I joined this association. That meeting with you of myself and one or two others was for the purpose of discussing this matter, but at that time we could not offer any suggestions except our good-will. I believe this matter should be adjusted and that there should be an amalgamation of these two organizations. So far as the running out of material by the younger organization goes, they will never run out of material, but that is no argument for non-consolidation, and I think we should use our best efforts to consolidate these two organizations. I think we should take out the three dollar proposition, but that the rest of the proposition should go through.

Mr. Hallock: I do not oppose the amalgamation of these two organizations, but I do believe the society should be better informed before taking action on the recommendation of the executive committee. I would like to move that this society extend to the Association for the Standardization of Paving Specifications a most cordial invitation to amalgamate with this association, the only conditions being that the members of the association who are already members of this society, remain members of the society as they are, without any change in their status; and that the funds of the association at the time of the amalgamation be used to pay the regular dues of such members as may desire to become members of the society.

Mr. Craig: I will second that.

Mr. Iredell: The Standardizing Association is doubtless under obligation to those cities represented in it to give them something for the money they have put in.

The President: I think that has been done to a very large extent. Those cities I believe feel that their money's worth has more than been secured. Three books have been gotten out in good shape and have been distributed to the cities, and the cities have been repaid very well. I do not think there will be any further obligation upon the men who have gone into the association for further work for the cities. Unless there were an additional payment, the work could not be continued much longer than the next session.

Mr. Reimer: Are the requirements for membership in this other organization practically the same as in our own?

The President: They are a little more stringent, but they would come in under our own requirements.

Mr. Ewart: It seems scarcely wise for this society to attempt to dictate how the money of that organization shall be spent.

Mr. Parkes: After stating that the money shall be used to pay the dues, why not add, "Or otherwise disposed of as the said Society for Standardizing Specifications shall see fit?"

Mr. Collier: I think we should think of the advantages we are going to get out of this amalgamation and that we should brush aside these little matters.

Mr. Parkes: I would like to amend Mr. Hallock's motion by striking out the last part "and that the funds of the association shall at the time of the amalgamation be used to pay the regular dues of such members as may desire to become members of the Society."

Mr. Ewart: I will second the amendment.

(*Amendment carried.*)

(*Vote taken on original motion as amended, motion carried.*)

Mr. Anderson: How shall we convey this information to the Association for Standardizing Paving Specifications?

Mr. Hallock: I move that the chairman of this convention appoint a committee of three who are also members of that organization to be present at the Pittsburgh meeting and convey to that association our cordial invitation for amalgamation, and that our president be one of the committee.

Mr. Rankin: I think that a copy of our motion should be forwarded to them at once, so that their Executive Committee can have it before them before the Pittsburgh meeting. I will second the motion.

Mr. Hallock: I will accept that recommendation as a part of the motion.

(*Motion carried.*)

The President: I will appoint Mr. Craig and Mr. Christ.

The Secretary: I have a letter here which I would like to to read, from Mr. Rust.

A. Prescott Folwell, Esq.,
Secretary American Society of Municipal Improvements,
Oriental Hotel, Dallas, Texas.

Dear Mr. Folwell: It is with a great deal of regret that I have to deprive myself of the pleasure of meeting you all this year. This is the first convention I have missed since I became a Member of the Society. I looked forward for months to the pleasure of going to Dallas, especially as it was largely through me that you decided to meet in Dallas.

As you know, I have only recently come to Victoria and within the last week I have been appointed Water Commissioner, which adds very much to my present duties, and I feel I am hardly justified in sparing the time it would take to attend.

I like Victoria very much indeed. The work so far is very pleasant and congenial, and the climate is delightful.

Will you please give my kindly regards to all my friends. Wishing you all a very pleasant and profitable meeting, and with kind regards,

Yours very truly,

C. H. Rust.

The President: On account of the position that Mr. Rust holds with us, and because of the feeling each one of us has for him, I think we should take some action and let him know we miss him.

Mr. Giddings: I move the secretary be instructed to communicate the sentiments of the convention to Mr. Rust, that we regret very much he is unable to be with us.

Mr. Howell: This should be sent by telegram. I will second the motion.

(*Motion duly carried.*)

The President: The next order of business will be the election of officers for the ensuing year. You will now listen to the report of the Nominating Committee, Mr. Fisher, Chairman.

Report of Committee to nominate Officers of the Society for the coming year, to the American Society of Municipal Improvements:

Your nominating committee begs leave to report the following names for the several positions indicated for your consideration:

President...........B. E. Briggs, Erie, Pa.
1st Vice President...Edward H. Christ, Grand Rapids, Mich.
2nd Vice President..William A. Howell, Newark, N. J.
3rd Vice President..A. F. Macallum, Hamilton, Ont. Canada.
Secretary..........A. Prescott Folwell, New York City.
Treasurer..........E. L. Dalton, Dallas, Texas.
Finance Committee...
  E. S. Rankin, Newark, N. J.
  L. V. Christy, Wilmington, Del.
  E. E. Colby, Chickasha, Okla.

E. A. Fisher,
M. Nicholson,
Fred Giddings,
Wm. J. Parkes,
A. W. Dow,
Committee.

Mr. Howell: I move that the report be accepted.
(*Motion seconded by Mr. Hallock and carried.*)

Mr. Hallock: I move the secretary of the society be instructed to cast one ballot for the nominees mentioned in the report of the committee.

(*Motion seconded by Mr. Macartney, and carried, and ballot so cast by the Secretary.*)

The President: The next will be the selection of place of meeting for the convention of 1913. Mr. Howell is chairman of that committee and we will now hear his report.

Report of committee for the Selection of Place for holding the 1913 Convention:

The following invitations have been received and considered by the Committee: An invitation from the Mayor of the city of Boston, supplemented by telegrams from Pawtucket, R. I., Cambridge, Mass., Springfield, Mass., New Bedford, Mass., Westfield Mass., Providence, R. I., all urging the claims of Boston. Invitations were also received from the Minneapolis Civic and Commerce Association, The Colorado Springs Chamber of Commerce, The Washington, D. C. Chamber of Commerce, Buffalo, N. Y. Chamber of Commerce, Louisville Convention and Publicity League, The Mayor of Niagara Falls, N. Y., and from the various municipal bodies of the city of Wilmington, Del. A delegation from the city of Wilmington made up of 3 members of this society appeared before the Committee to urge the claims of that city. An invitation from various civic bodies in San Francisco to hold the 1915 Convention in that city was also received. The delegation from the city of Wilmington presented such convincing arguments in favor of their city that the committee unanimously decided to report in favor of Wilmington as the Convention City for 1913.

Mr. Craig: I move that the report be accepted.
(*Seconded by Mr. Reimer and carried.*)

Mr. Reimer: I move that the secretary be instructed to cast the ballot of the society for the city of Wilmington, Delaware, as our next convention city.

(*Motion seconded by Mr. Rankin, and carried.*)

CONVENTION INVITATIONS

The following letters and telegrams were received by the president and secretary of the society and handed over to the Committee on Next Place of Meeting, and considered by them in the preparation of their report.

American Society of Municipal Improvements,
Dallas, Texas.

Gentlemen:—If you will refer to the printed record of the Proceedings of the eighteenth annual convention of your society, you will notice that Hon. George W. Sparks, President of the Board of Directors of the Street and Sewer Department of the city of Wilmington, Del., stated that an invitation would be presented at this meeting for the society to meet in Wilmington in 1913.

On behalf of the Honorable the Mayor, the Council, the Board of Health, the Board of Police Commissioners, the Board of Park Commissioners, the Board of Water Commissioners, the Wilmington Board of Trade, the Engineers Society of Delaware and the Board of Directors of the Street and Sewer Department of the city of Wilmington, Delaware, we renew the invitation and cordially ask you to meet in Wilmington in 1913.

Respectfully,
(Signed) George W. Sparks,
C. A. Rudolph,
M. D. Murphy,
Board of Directors of the Street and Sewer Department.

Attest L. V. Christy, *Secretary.*

Night Letter

E. A. Kingsley, *President,*
American Society of Municipal Improvements,
Dallas, Texas.

Wilmington Board of Trade extends cordial greeting to you and through you to the delegates attending the nineteenth convention of the American Society of Municipal Improvements and expresses the sincere wishes of the industrial, commercial and financial interests of Wilmington that you select this city for your twentieth convention. Wilmington is ably represented at your convention in Dallas by our Street and Sewer Directors and their Secretary and we trust you will honor this city by accepting their invitations.

R. J. MacLean,
Business Manager.

In response to letters sent out by the Wilmington officials, letters were received from the following members of the society expressing their desire that Wilmington be selected for the 1913 convention.

Henry C. Allen,
Horace Andrews,
C. C. Brown,
George A. Carpenter,
Fred R. Charles,
S. Cameron Corson,
W. W. Crosby,
L. D. Cutcheon,
Andrew J. Gavett,
A. C. Gregory,
Harry F. Harris,
J. N. Hazlehurst,
P. W. Henry,
Rudolph Hering,
Nicholas Hill, Jr.,
John B. Hittell,
J. W. Howard,
Nelson P. Lewis,
W. H. Luster, Jr.,
John McNeal,
L. Vincent Metz,
Joseph O'Neil,
C. H. Rust,
J. L. Slattery,
George W. Tillson,
Isaac Van Trump,
J. H. Weatherford,
Linn White,
Nisbet Wingfield.

November 4, 1912.

To the Delegates to the Convention of the American Society of Municipal Improvement, in Convention at Dallas, Texas.

Gentlemen:—The Chamber of Commerce of Washington, D. C., *Your Capital City* and the most beautiful city in the world, extends to you a cordial invitation to hold the 1913 meeting in Washington and promises to do everything in its power to see that the Convention is a success from every viewpoint.

You cannot but recognize the advantages of Washington from a conventions standpoint. It is, as above stated, the Capital of the Nation, your capital and your nation. It is beyond a doubt, the most beautiful city in the world and has more to interest you than any other dozen cities in the United States. Its magnificient public buildings, its clean streets, its beautiful public parks, its palatial residences, and its hotel accomodations are World-famed. It abounds in points of historical interest and within very close proximity are the battlefields of the decisive engagements of the Civil War. A visit to Washington is an education. You owe it to yourself to come here and it should be a part of the education of your children to visit Washington. Again, your Association is undoubtedly interested in National Legislation and where could you hope to get better results than right here in Washington if it is your pupose to work for any certain legislation.

I trust, gentlemen, you will see the force of my arguments above, which are but a few of the many in favor of Washington, and that you will vote to come here and thus insure for the Association a most successful and pleasant session.

Very truly yours,
Jno. Delph,
Chairman, Conventions Committee, Chamber of Commerce.

July 9, 1912.

A. Prescott, Folwell, *Secretary,*
American Society of Municipal Improvements,
New York City.

Dear Sir:—Buffalo desires to renew its invitation to your association to meet in this city, and I am addressing this letter to you to ask if you will be so courteous as to present a renewed invitation at the coming convention at Dallas, Texas.

Thanking you for your attention, I am

Yours very truly,
CONVENTION BUREAU
Henry B. Saunders,
Commissioner.

Mr. A. Prescott Folwell, *Secretary,*
American Society of Municipal Improvements,
New York City, N. Y.

Dear Sir:—Would an invitation to hold its next convention in Colorado Springs be favorably considered by The American Society of Municipal Improvement?

You will recall previous correspondence on this subject of selecting Colorado Springs as a meeting place for your convention.

Wouldn't your delegates welcome the opportunity to spend a few days of recreation enjoying the wonderful scenery of the Pikes Peak Region? They have been meeting for years in the big cities, which are more centrally located than Colorado Springs, but don't you think they would be willing to go a little farther if they could combine with the convention a vacation in the mountains?

Colorado Springs can provide your delegates with the best of hotel accommodations at rates which they will consider proportionate to the services.

The crisp, autumn months are the most delightful of the year in Colorado.

Very truly yours,
A. W. Henderson,
Secretary, Chamber of Commerce.

Night Letter

A. P. Folwell,
Secretary American Society of Municipal Improvements,
Dallas, Texas.

Your society cordially invited meet Niagara Falls next. Principal hotels rebuilt and enlarged. Splendid service, reasonable rates, central location, best railroad rates, delightful climate, enjoyable side trips, new water works, ideal filtration, falls to be illuminated, new state roads and boulevards, magnificent scenery, meeting place free and liberal entertainment.

P. J. Keller,
Mayor.

Night Letter

E. A. Kingsley,
President American Society of Municipal Improvements, Dallas.

Spokane chamber of commerce, eleven hundred members, endorses Wilmington Del., for your convention of nineteen thirteen and extends cordial invitation to your society to come to the west in nineteen fifteen. Meet in Spokane and then visit other western cities and Panama Pacific Exposition. Wilmington board of trade will entertain you royally.

H. C. Wuerth,
Secretary Chamber of Commerce.

November 7, 1912.

Mr. E. A. Kingsley,
President, American Society of Municipal Improvements,
Dallas Chamber of Commerce, Dallas, Texas.

Dear Sir:—Having been informed of the movement to have your organization meet in 1913 at Wilmington, Delaware, we are taking this occasion to both endorse the invitation of our Atlantic Coast neighbor, as well as urge that your organization hold its annual session the following year in Seattle. So far as we can ascertain, although this is a national organization, representative of the East, South, North and West, no convention has ever been held in the Northwest or on the Pacific Coast. We apprehend that were such a meeting to be held in Seattle in 1914, the attendance would be heavy, not only from Eastern members of the organization, but also from the membership west of the Mississippi River which has heretofore had little opportunity to attend these gatherings on account of the distance necessary to travel. I can assure you that Seattle and the other cities of the Northwest will present a showing of municipal improvement equal, if not superior to any other cities of like age and size in the United States.

Hoping to hear that you have given this matter favorable consideration and that I may have the opportunity in 1914 of extending my personal thanks on the occasion of your convention in Seattle, I remain,

Yours very truly,
R. H. Mattison,
Secretary Chamber of Commerce.

November 8, 1912.

Mr. E. A. Kingsley, *President,*
American Society of Municipal Improvements,
Dallas Chamber of Commerce, Dallas, Texas.

Dear Sir:—It is my understanding that the Board of Trade of Wilmington, Delaware, has issued an invitation to your society to hold its next convention in that city. In this connection, it gives me great pleasure to assure you that the fact that Mr. R. J. Maclean is Manager of the Board of Trade at Wilmington is a guarantee that your organization would be splendidly taken care of in Wilmington, and you would not regret holding the convention there. Mr. Maclean made a reputation in the way of securing conventions in the city of Spokane, and you will take no chances in meeting in the city of Wilmington.

In this connection, permit me to call your attention to the fact that the members of your Society in the Western country are very few and to express the opinion that possibly this is due to the fact that you have never held a convention in the West.

Why not consider it advisable of doing so, and then going a step further and considering it advisable of holding your 1915 convention in Sacramento, the Capital City of the state of California, the state which is the richest of all states of the union in resources, climate and scenery?

Yours very truly,
S. Glen Andrus,
Secretary-Manager, Sacramento Chamber of Commerce.

September 3, 1912.

To the Members of the American Society of Municipal Improvements.

Gentlemen:—In behalf of the community of San Francisco, I have the honor to extend to you herewith a cordial and sincere invitation to hold your convention for the year 1913 in San Francisco. The people of this city will be proud, indeed, to become your hosts upon that occasion, and we feel that we will be able to entertain you in a befitting manner. The great task of building the world's Fair for the year 1915, when the opening of the Panama Canal is to be celebrated, will then be in progress and it will afford the members of your Society an opportunity to view one of the greatest engineering feats of modern times.

San Francisco will be glad to throw her golden portals open to you and bid thrice welcome, and her people entertain the hope that they may soon learn of your determination to honor them with your presence here in 1913.

Yours very sincerely,
Felton Taylor,
Secretary, San Francisco Convention League.

August 22, 1912.

MR. A. P. FOLWELL, *Secretary,*
American Society of Municipal Improvement, New York.

DEAR SIR:—Many of the members of your Association are certain, in any event, to visit San Francisco and California in 1915. Would it not be worth while to ensure a very large attendance by combining your meeting of that year with the attractions of the Exposition?

The Congresses and Conventions which will be held in San Francisco at the time of the Exposition will be the most extraordinary that the world has every witnessed. Eminent men and women will be brought here in every line of thought. One feature of the 1915 Exposition will be the great encampments on the shores of the Golden Gate, where entire organizations may be brought together under the most charming conditions of tent life and at an expense that can be made to suit any purse.

I will be much indebted for any expression of opinion or suggestions from you.

Yours truly,
JOHN BRISBEN WALKER,
Director of Congresses, Panama-Pacific International Exposition.

October 28, 1912.

MR. A. PRESCOTT FOLWELL,
Secretary, American Society of Municipal Improvements,
50 Union Square, New York City.

MY DEAR MR. FOLWELL:—As you probably know, a vital element of the Panama-Pacific International Exposition, to be held in San Francisco in 1915, will be its Congresses and Conventions. The Directors of the Exposition have been so impressed with the value of these world gatherings that they have set aside One Million Dollars for the erection of a great auditorium in which they may be held.

Under separate cover, I am mailing to Dallas a formal invitation from the Exposition to hold your 1915 meeting in San Francisco.

One of the great departments of the Exposition will be that of Social Economy. In connection with this department, might it not be well for the Society of Municipal Improvements to consider holding its 1915 meeting in San Francisco? It seems to me that you might use the department as a sort of laboratory, basing your program for the year, to a certain extent, on the Exposition exhibits. I enclose the tentative classification of the Social Economy Department. You will understand, of course, that this classification is still under consideration, but will be adopted in its final form at an early date. I trust that you will go over it carefully and consider both the plan and the possibilities of meeting in San Francisco, in 1915, at your Convention to be held on November 12th at Dallas, Texas.

Should your Society decide to meet in this city in 1915, we shall be glad indeed to arrange for suitable halls for the session, either in the auditorium or elsewhere, as may be most convenient for you. We shall expect, of course, to furnish meeting places without expense to the Society.

I am sure that very many of your members will wish to visit California, in 1915, and for that reason it would be desirable to combine your annual meeting with the activities of the Exposition.

I will say that forty-six organizations have already formally voted to meet in this city in 1915. Fully three hundred other learned societies and other organizations are considering the matter with considerable favor.

Trusting that your coming Convention may be a most profitable one, and awaiting your reply, I am,

Very sincerely yours,
Jas. A. Barr,
Manager Panama-Pacific International Exposition.

NIGHT LETTERS

November 12

Mr. E. A. Kingsley,
President American Society of Municipal Improvements,
Oriental Hotel, Dallas, Tex.

The undersigned join in a cordial invitation to your association to select Boston for your convention city of 1913. We can assure you a cordial welcome and we have many public works which will be of interest to your members. Your association has never visited New England and the selection of Boston, the principal New England city, should result in a large and increased membership. We trust you will honor us by accepting this invitation.

John F. Fitzgerald,
Mayor of Boston, Mass.
Louis K. Rourke,
Commr. of Public Works, Boston, Mass.

November 13

E. Kingsley,
President American Society of Municipal Improvements,
Oriental Hotel, Dallas, Tex.

Boston Chamber Commerce cordially invites your society to meet in Boston next year.

Joseph B. Russell,
President.

November 13, 1912.

E. A. Kingsley,
American Society of Municipal Improvements,
Oriental Hotel, Dallas Texas.

Greetings from Connecticut. I hope you are having a profitable meeting and before you conclude deliberations you will vote to hold next convention at Boston, Mass. New England needs you. Simply swell chorus from New England by extending to your convention a hearty welcome.

JAMES H. McDONALD,
State High Way Commissioner.

PRESIDENT A. KINGSLEY, November 12, 1912.
Oriental Hotel, Dallas, Texas.

Your society is urged to hold convention in Boston. There are many things here your members could easily see, especially various kinds and character of road construction, state highways, parkways, city streets and parks. The Highway commission will be glad to do what it can to help.

WM. D. SOPHER.

November 12, 1912.

E. A. KINGSLEY,
President American Society of Municipal Improvements,
Oriental Hotel, Dallas, Tex.

The Massachusetts Highway Association, composed of three hundred street superintendents, city and town engineers, park superintendents and other live road men, urge that your society hold its nineteen hundred and thirteen convention at Boston, the lovliest and most interesting convention city in the country. Why not come?

J. M. McCARTHY,
Secretary.

November 12, 1912

E. A. KINGSLEY,
American Society of Municipal Improvements,
Convention Hall, Dallas, Texas.

Cambridge cordially joins with Boston inviting your society to meet in Boston next year. Cambridge is the home of Harvard University, Institute of Technology, rich in historical associations. Lately has been opened the finest subway in the world. Has excellent parks and playgrounds.

J. EDWARD BARRY.
Mayor.

November 11, 1912.

E. A. KINGSLEY,
President American Society Municipal Improvements,
Oriental Hotel, Dallas, Texas.

Believe your society will profit in membership and attract interest in New England by holding next meeting in the east. Hope society will accept Boston's invitation for nineteen thirteen.

GILES W. EASTERBROOKS,
Mayor of Pawtucket, R. I.

E. A. Kingsley,
President American Society of Municipal Improvements,
Oriental Hotel, Dallas, Texas.

I respectfully urge acceptance of Boston's invitation to hold nineteen thirteen convention there. Interest in good road movement throughout New England would certainly be stimulated.

E. H. Lathrop,
Mayor of Springfield, Mass.

November 12, 1912.

E. A. Kingsley,
President American Society of Municipal Improvements,
Oriental Hotel, Dallas, Texas.

I hope your society will designate Boston, the principal city of New England, for your convention of nineteen thirteen. The city of Newton has many miles of highways and other municipal improvements which should be of interest to your members which you are cordially invited to inspect.

Charles E. Hatfield,
Mayor of Newton.

November 12.

E. A. Kingsley,
President American Society of Municipal Improvements,
Oriental Hotel, Dallas, Tex.

I believe convention for next year should be held in Boston. All New England interested.

Chas. S. Ashley,
Mayor of New Bedford, Mass.

November 13, 1912.

E. A. Kingsley,
Oriental Hotel, Dallas.

Heartily endorse holding your 1913 convention in Boston and trust you will decide to accept city's invitation.

John L. Hydes,
Town Engineer of Westfield, Mass.

November 12.

E. A. Kingsley,
President American Society of Municipal Improvements,
Oriental Hotel, Dallas, Tex.

Would urge as of great interest to New England cities that Boston be selected for your nineteen hundred and thirteen meeting.

Henry Fletcher,
Mayor of Providence, R. I.
Walter F. Slade,
Commr. of Public Works.

November 11, 1912.

E. A. KINGSLEY,
President American Society Municipal Improvements,
Oriental Hotel, Dallas, Texas.

Have already expressed a choice for Wilmington, Del., for nineteen thirteen convention, but if that city is not selected would favor Boston as second choice.

GEO. A. CARPENTER,
City Engineer, Pawtucket, R. I.

THE PRESIDENT: We will now hear the report of the secretary on the constitutional amendments proposed.

THE SECRETARY: One of the amendments suggested yesterday was amending the constitution so as to permit the adoption of the proposed consolidation, that is, permitting the members of the A. S. P. S. to come in and pay two dollars instead of five dollars. After what we have done, that is, of course, unnecessary. The next was that we add to Section II, Article 2, a provision that "election shall take effect upon the payment of the dues to the end of the current year." There have been cases where gentlemen have signed application blanks requesting membership in the society, their requests have been accepted by the Executive Committee, their names appeared upon the rolls of the society as members, and they have received the publications of the society for two years, and have not paid one cent to the society, either at the time they entered or any other time. That does not seem right, and while the money does not mean so much to the society, yet it does mean something. Last year you may have noticed we dropped twenty-nine members for non-payment of dues, and quite a number had never paid a cent. Our rule is to drop a member when he is two years back in his dues. If we adopt this, we shall be able to reduce this somewhat bad showing of dropping members for non-payment of dues.

MR. SMITH: I move that this amendment be adopted.
(*Motion seconded by Mr. Giddings and carried.*)

SECRETARY: At the previous convention we provided for a Committee on Convention Papers, the purpose of which was to examine all papers to be submitted at the convention and eliminate any objectionable matter in such papers, if there was any such, in the way of advertising or personalities or anything of that kind that might be objectionable. Such a committee was appointed. One of the members of the committee lives in the far Northwest where it takes two weeks to get a paper to him and back again; another is in Brooklyn and another in Newark—fortunately close together and close to the secretary. It was also provided that the secretary publish before the convention as many papers as possible, and we hold that open as long as possible to get as many papers as we can and still be able to send out the pamphlet a week in advance of the convention. To hold that open as long as possible, and still to get the papers before the Committee on Convention Papers means close connections between the secretary and that committee. This year Mr. Tillson had obtained the consent of Mr. Rust and Mr. Sherrerd to represent the committee in passing on these papers. Mr. Tillson was close to me and I would send a messenger over with the papers, and he would send them right back. There is this year the additional difficulty that there is not a member of that committee at the convention. So it was thought desirable by the Executive Committee to amend that provision so as to make the secretary of the society the chairman of the Committee on Convention Papers.

MR. CRAIG: I move the adoption of that amendment.
(Motion seconded by Mr. Rankin and carried.)
Meeting adjourned to 2 p.m.

AFTERNOON SESSION

Meeting called to order by the President at 2.30 o'clock.

THE PRESIDENT: We will finish up this morning's papers. I will ask the secretary to read Mr. Hazlehurst's paper, on "The City Engineer and Health Board."
(The Secretary reads Mr. Hazlehurst's paper.)

THE PRESIDENT: We will next have the paper of Mr. Baumgartner, city engineer of Dubuque, Iowa, on "Method of Supporting Sewers in Deep Fills."
(The Secretary reads Mr. Baumgartner's paper.)

The President: We will next have the paper of Mr. T. C. Hughes, city engineer of Tulsa, Okla.

(*Mr. Hughes reads his paper.*)

Mr. Craig: It has come to our notice that the wife of Mr. Lenderink, of Kalamazoo, has been taken sick and is at the hospital. I move we convey to the husband of Mrs. Lenderink our sympathies and that we present her with a bouquet of flowers.

(*Motion seconded by Mr. Myers and carried.*)

The President: We will next have the report on Standard Specifications. I will ask Mr. Fisher to preside over the deliberations of the committee.

(*Mr. Fisher reads report of committee.*)

REPORT OF GENERAL COMMITTEE ON STANDARD SPECIFICATIONS

Your special committee, appointed by the president to act at this convention in the absence of the chairman of the committee on standard specifications, begs leave to present a communication from Charles C. Brown, chairman of said committee, unavoidably detained by sickness in his family, and also a report from the sub-committee on standard sewer specifications, signed by E. J. Fort, A. J. Provost, Jr., and Rudolph Hering, all the members of said committee. Also a report from Linn White, chairman of the sub-committee on bituminous paving. Also a report of the sub-committee on concrete paving specifications, signed by Fred R. Charles, chairman. Also a letter from William W. Southgate relative to bituminous pavements not infringing on patented pavements.

A. W. Dow will present the report of the sub-committee on wood block specifications.

E. H. Christ has some minor suggestions relative to the brick specifications heretofore adopted.

George W. Craig, chairman of the sub-committee on asphalt paving, will suggest some corrections in the specifications adopted.

Your general committee recommends the presentation of the foregoing reports to this convention, and further suggests that the committee on standard specifications, together with all subcommittees, be continued, to the end that the matters may be further considered both by the sub-committees, the standard committee and the society itself, especially in view of the proposed amalgamation of the Association for Standardizing Paving Specifications with this society.

E. A. FISHER, *Temporary Chairman,*
E. H. CHRIST,
GEO. W. CRAIG.

THE PRESIDENT: If there is no objection, the report will be accepted and placed on file.

MR. FISHER: The first sub-committee is that on Brick Paving. Mr. Christ is chairman.

(*Mr. Christ reads report.*)

REPORT OF SUB-COMMITTEE ON BRICK PAVEMENT SPECIFICATIONS

Your Committee on Brick Specifications have but a few changes to submit, and these are made to conform to the specifications adopted by the Association for Standardizing Paving Specifications at New Orleans last January.

The first paragraph of section 4 on page 134 of the 1911 Proceedings was changed to read: "The brick shall not lose of their weight more than 22 per cent after being submitted to the following test." And a footnote is inserted to read:

Note: Where medium or light traffic or other conditions exist, which, in the opinion of the engineer, do not require a brick capable of giving an abrasive loss of 22 per cent, brick of a quality which will give a loss of 25 per cent or even 28 per cent may be used.

On page 143, in paragraph 4, after the words 32° F. the following was inserted: "and in no case shall any material containing frost be used."

The word "side" in the last line of the first paragraph of section 17 was changed to "edge."

In the last part of paragraph 2 of section 21, which read "With section 21 of said specifications amended to read as follows," the following was inserted: "with subsequent amendments." Paragraph 3 of section 21, to which the above refers, was cut out entirely.

In section 24, under asphalt filler, the percentage of bitumen soluble in carbon disulphide was changed from 92 to 98 per cent.

The last two lines of section 23, which read "The filler shall be such that it retain its consistency under extreme temperature," were placed in paragraph 2 of section 22 after the word "joint."

E. H. CHRIST, *Chairman,*
HENRY MAETZEL,
F. J. CELLARIUS.

MR. HALLOCK: I should like to provoke a discussion as to whether or not it is advisable to establish a minimum abrasion loss. We specify a loss of not more than 22 per cent. The result has been in Newark that we are getting a great deal of brick 15, 16 or 17 per cent of loss, which, to my mind, gives us too hard a brick. I think it will become necessary to establish a minimum as well as a maximum.

THE PRESIDENT: It has been suggested by a number of the members of these standard committees that these points be taken up in the interim between this convention and the next meeting. These things come up just prior to the meeting, and in a day's time it is impossible to get together the ideas and data and statistics on matters of this kind. It would be very beneficial and would greatly aid the committees if the members would take up during the year such things as they want considered by the committee in the way of standardizing the specifications.

MR. CHRIST: We considered Mr. Hallock's suggestion, and did intend to draw up something along that line; but it needs careful consideration, especially for anyone putting in a brick street of more than 22 per cent, because you might get a brick that would test 16, and another one 25 and the variation is too great. There are some details in the way of doing this work that we hope to have further information on by the next meeting. We have received from the National Paving Brick Manufacturers Association requests for changes in the specifications. I will read them.

To the Sub-Committee on Brick Paving, American Society of Municipal Improvements:

The undersigned, representing the National Paving Brick Manufacturer's Association, respectfully submits, for the consideration and action of your Committee, the following changes and modifications in the brick pavement specifications, which were heretofore adopted by your organization September 27, 1911, viz:

First: That Section One, in the third line thereof, be changed to read "one-fourth" instead of "one-eighth;"

Second: That the word "one-eighth," in the sixth line of the third paragraph of Section One, be changed to read "one-fourth;"

Third: That the word "marked," in the second line of the second paragraph of Section One, be changed to read "material;"

Note: It is not the purpose of this suggestion to raise discussion concerning open laminations;

Fourth; After the work "shall," in the third line of Section Two, in lieu of that which follows, the same shall be made to read "Be assembled and if brick in piles of 25 or more and removed from the street immediately after the street is ordered open for traffic";

Fifth: That instead of the lines three and four of the third paragraph of Section One, ending with the word "marks," there shall be substituted the following, "the best face of the worst brick shall not be over one-eighth of an inch out of a plane at any point and the worst face of the worst brick shall not be over three-eighths of an inch out of plane at any point."

MR. THOMPSON: Have the words "heavy traffic," "light traffic" and "medium traffic" been stricken from the specifications?

MR. CHRIST: Yes, but they have been put in under notes, so that the engineer can use whatever he thinks is best.

MR. THOMPSON: Those words are unfortunate. What would be a heavy traffic street in one city would be a light traffic street in another.

MR. CHRIST: We only make standard specifications of one kind, and that is for the best.

MR. DICKEY: How much difference is there in the percentage of loss of brick tested by the new rattler as compared with the old standard rattler?

MR. CHRIST: In our city we made extensive tests, and we found about 4 per cent difference where it was 18, so we use 22 now.

The President: The association as an association took no note of these things. These tests have been made by the members of this committee and other individuals.

Mr. Giddings: I move that we adopt the report of the Committee.

(*Motion seconded by Mr. Thompson and carried.*)

The President: The next is the sub-committee on Bituminous Paving, Linn White, Chairman. Mr. Fisher will read his report.

REPORT OF COMMITTEE ON BITUMINOUS PAVING SPECIFICATIONS

Your sub-committee on bituminous paving has not prepared the report it desires to present at this meeting. As your committee understands its instructions, it was to prepare and present specifications for bituminous pavements, particularly what has been known as bituminous concrete pavements, that will not infringe upon any patents for this class of construction. This is an important commission and one not to be undertaken lightly or executed hastily. Your committee appreciates that if the seal of approval of the American Society of Municipal Improvements should be set upon its efforts in this direction it is probable many engineers would feel themselves justified in following the approved specifications. If as a result municipal bodies should find themselves involved in patent litigation, this society, as well as its committee, would be seriously discredited. Appreciating the gravity of the situation, your committee has desired to proceed cautiously in the matter and not attempt to present a specification that has not been carefully considered, not only from an engineering but also from a legal standpoint. Considerable information along these lines has been collected by your committee but has not been properly tabulated and discussed by members of the committee nor properly reinforced by legal advice to be presented at this time. If this society should see fit to continue the committee, it is hoped to be able to present a report a year hence which may be expected to carry considerable weight.

It is desired to call the attention of the general committee and that of the society to the specifications for bituminous concrete adopted at the 1912 meeting of the Organization of City Officials for Standardizing Specifications, which included two specifications, for convenience designated as Specification "X" and Specification "Y." Specification "Y" was recommended by the committee and adopted by the organization as a specification which "provides for a construction about which there can be no question raised of patent infringement." The Organization for Standardizing Paving Specifications holds its 1913 meeting in Pittsburgh, at which no doubt this particular phase of the question will again be discussed.

Your sub-committee, if its life should be continued, invites correspondence from the members of this society upon the subject of patented bituminous pavements and will be grateful for any information or suggestion upon the subject.

LINN WHITE,
Chairman.

THE PRESIDENT: We will next have the report of Mr. Craig's sub-committee on Asphalt Paving.

MR. CRAIG: We have had some suggestions as to the improvement of the asphalt paving specifications. We have gone over these matters carefully, and there are a few suggestions, largely those of corrections to specifications heretofore adopted. I will read the proposed amendments. On page 22 of the pamphlet published by the society, after the word "asphalt," the last word of the first paragraph, it is proposed to insert "If desired, the contractor may use an asphalt cement prepared at the refinery. To be acceptable, this asphalt cement must comply with the foregoing general requirements for refined asphalt, as well as requirements a, b, c, d and e for asphalt cement."

This suggestion covers one where the consumer desires to use a fluxed material, getting it direct from the refinery.

Then under paragraph a, the fifth paragraph from the bottom of the page, it is proposed to make that read "weight for five seconds." This was one second. Then on the next page, to make it more clear, we have designated the sieve that the material shall be retained on.

(See matter concerning "Binder Stone" and "Sand" as printed in the specifications for Asphalt pavement elsewhere in these Proceedings.)

On page 26, at the end of paragraph e, we have added "the two ends of the briquette to be pulled apart at the uniform rate of 5 cms. per minute."

MR. EWART: I move that the report on Asphalt be accepted. *(Motion seconded by Mr. Nicholson and carried.)*

MR. FISHER: The next is the report of the sub-committee on Wood Block, by Mr. Dow.

MR. DOW: In presenting to you the report of the Committee on Wood Block Paving Specifications we beg to say that we have made a few changes in the specifications presented to the society in 1910 and published in the Seventeenth Annual Proceedings. These changes are as follows:

In the paragraph on timber we have substituted for "long leaf" the term "commercial" in hopes that by so doing there will be less dispute as to the character of the wood. In the past many have supposed that specifications calling for long leaf yellow pine intended the botanical interpretation and not the commercial interpretation of this term. To have a contract filled with nothing but botanical long leaf yellow pine would be almost impossible nowadays and would bring the pavement to an excessive price. For this reason we have substituted the term "commercial" and intend that it shall include good qualities of loblolly and short leaf pine along with the long leaf yellow pine.

We have made a change in specifying the number of annual rings per inch by substituting four for three as the minimum number of rings allowed per inch. In the following line we have substituted for four annual rings five annual rings. These changes are made on account of criticisms that our specifications allowed too coarse grain.

In the paragraph on oil we have made considerable change so as to admit a lighter oil as well as the heavy coal tar oil called for by the previous specifications. This has been done owing to criticisms of the former specifications that they were too restrictive and allowed the use of a product manufactured by only one concern in the country. The oil asked for is still a very heavy oil, but the committee unanimously believe that the best results can be obtained with it. The specifications now admit either a very heavy distillate oil or a heavy refined coal tar mixed with heavy distillate oil. The specifications for the oil now read:

1. The specific gravity shall be at least 1.08 to 1.14 at a temperature of 38 degrees C.

2. On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering and Maintenance of Way Association, the distillate shall not exceed 2 per cent up to 150°C. and not less than 30 nor more than 50 per cent at 315°C. The mean of three determinations to be taken.

3. Not more than 4 per cent of the oil shall be insoluble in hot benzol and chloroform.

In all other respects they are similar to those presented in 1910.

Mr. Nicholson: Did we not have an alternative specification, using light and heavy oil?

Mr. Dow: No; this society never had.

Mr. Richardson: Do I understand that the specifications now drawn do not admit creosote?

Mr. Dow: They do admit it.

Mr. Richardson: 1.03 to 1.08? That is the ordinary creosote oil. That is the ordinary dead oil of commerce.

Mr. Dow: 1.08 to 1.14 includes the ordinary creosote oil of commerce. The District of Westminster, just outside of London, has specified 1.08 for their oil this year.

Mr. Fisher: We have just received from Mr. J. W. Howard the following telegram:

> To help provide for as durable wood pavements as possible and help assure competition for streets where wood is suitable to be used, kindly present for final adoption by the Society my resolution in reference to wood pavements on pages three hundred eleven, three hundred twelve, proceedings of nineteen eleven.

The resolution he refers to is as follows: "Resolved, that in reference to wood pavement this society advises that cities permit the use of such wood pavements as have proven themselves to be durable and efficient in actual use on streets subject to severe climatic conditions and traffic, during at least eight or nine years; provided this shall not prevent the use of any kind, or kinds, of wood pavements or specifications providing for such other wood pavements as the city may decide to construct."

Mr. Myers: I move the adoption of Mr. Dow's report.

Mr. Christ: I will second it.

Mr. Dow: If I have used the word "creosote" in reading my paper, I did not intend to. I think it best to leave the word creosote out entirely. The specifications we drew included heavy grades of creosote along with mixtures of coal tar and creosote. I think we should call it a coal tar product, to comply with the following requirements.

Mr. Ewart: Why do you start at 1.08?

Mr. Dow: Because it has been found from experience that the lighter oils ooze out of the blocks on the street. That which comes out on the surface readily evaporates and gives but little trouble, but considerable oozes out of the bottom of the block. This oozing takes place to such an extent that in time the blocks are left without the full qnantity of oil, when they are naturally porous, taking up water swelling with every rain or dampening condition.

Mr. Richardson: That is a controversial question, in which I should not agree with Mr. Dow, because the ordinary oil has been used a long time for treating telegraph poles, where the air surface is much greater.

The President: Two paving block concerns have expressed to me the fact that they have been forced to abandon the light oil, because they could not satisfactorily procure it; that they were compelled to buy oil where they could get it, and take what the manufacturers would give them.

Mr. Dow: The reason why the light oil is successfully used in piling, telegraph poles and long timber and is not so desirable in wood block is because of the fact that oil, being absorbed by timber through the end of the fiber and not through the sides, it will much more readily run out of a piece of timber 4 and 5 inches in length, such as a wood block, than it will out of a long telegraph pole or pile several feet in length. There is also in a wood block a much greater surface area of the fiber end exposed proportionately to the size of timber than in a pile or pole, thus giving more surface area for the evaporation of the oil. I have seen pavements laid with light oil, where the light oil oozed out of the bottom of the block into the sand cushion, and produced a cementing material in the cushion, so you could lift up a square foot of the cushion. The better pavements at the present time are treated with heavy oil. This oil—1.08 to 1.14—can be obtained abroad and in this country. These are standard specifications and are supposed to be the best we can recommend. If a city wants to use light oil, they are at liberty to do so, but these specifications are the best we know for treating wood block. In many creosoting works they have one large supply tank. These works may be treating ties, telegraph poles and large timber, and then will change to wood block, and it is natural they want to use the same oil for wood block as for the timber; but we say it should be heavier.

Mr. Nicholson: With 1.08 to 1.14 specified, what would be the tendency—towards 1.08 or 1.14?

Mr. Dow: That would depend on the price of creosoting oil in the market. If the heavy oil was cheap, he would buy that. I personally believe the heavier oils with the tars are better than the lighter oils.

Mr. Nicholson: Could an engineer specifiy 1.10 under these specifications?

Mr. Dow: I think so, yes.

Mr. Collier: I think 1.08 to 1.14 is satisfactory. No doubt the manufacturer will hug near 1.14. Our experience has been that we like 1.08 better. We have never found blocks yet, down thirty years in some places, devoid of oil when taken up. Our prettiest streets were put down with 1.04 oil. Von Schrenk, our chemist, last January in a paper told us that we were spending too much time and too many hours of discussion on the specific gravity of oil. He said any oil made from coal tar preparations will have germicidal qualities enough to keep down the fungi. He wanted us to watch the construction more.

The President: I think that is right. If you get your preservative (if it is a preservative) into the wood, and get the pavement down right, and get the pavement on the class of street it should go on, and not on a street where there is no traffic at all or which is otherwise not adapted to that pavement, you will be all right. There are as many faults in the construction of wood block pavement as in the troubles from specific gravity of oil. The best blocks we have used in our city are those that have come just a little under the specifications. We have tried to adopt the standard specifications, so as to be in line with the rest of the country, and stick to this heavy oil, but I know from past experience that many streets laid years ago, before the manufacturing concerns forced us to take this heavy oil, had very good pavements. The method of construction should be looked into just as carefully as the specifying of an oil that does not come under 1.08.

Mr. Collier: I agree in emphasizing the fact that there is a great deal more in the careful construction of a wood block pavement than in the treatment of the block. One thing is that you should have a very low crown on a wood block street.

Mr. Dow: I believe many of the troubles are not caused by the oil, but by the way the block are treated after manufacture. An ordinary pine block will absorb 28 per cent of oil if you keep on soaking it into it. In some methods of treating, much of the water is dried out of the block and after you inject 18 pounds of oil you will then have a block with 10 per cent of voids. That block will naturally absorb water. The way a block should be treated is to be kept soaked full of water and of oil and kept wet until put down in the street. If the blocks are dried in transit, they should be soaked to put the moisture in. The city of Norfolk has taken that hint, and they have used a heavy grade of oil. Oil of 1.10 to 1.14 oozes badly when the blocks are improperly treated. I have here about twenty photographs taken of 1.08, showing expansion and oozing of blocks treated with 18 pounds, and you could not have anything worse. Cincinnati has had a bad experience with the use of distillate oil. These photographs were taken by the Bureau of Municipal Research to show the citizens what happened to these blocks laid two years ago. Here a wood block oozed so badly that the oil was tracked onto the asphalt, and practically ruined the asphalt pavement. I do not say the coal tar oils do not ooze, but this shows the coal tar oils are in the same class with the other oils.

Mr. Anderson: Do the specifications state as to the seasoning of the wood before the oil is applied?

Mr. Dow: They do not, to any extent.

Mr. Anderson: Would that be a matter of significance?

Mr. Dow: It would be nearly impossible to state that.

Mr. Anderson: Three years ago at the Wood Preserver's Convention at Chicago, the experts in charge of some of the creosoting plants—largely those treating railroad ties and bridge timbers—maintained that the cellular structure—the fiber in the wood—underwent certain changes if the wood was not properly seasoned, both as to the extent of the dryness and the period of storage; that in one case the structure would be hard so that the oil would not penetrate, and that in another case the cells would be broken down so that the oil would penetrate freely.

Mr. Dow: That question is being argued back and forth—that is, the action of the oil on the wood. I do not see any way we could specify the way of seasoning. We have found that a very well seasoned wood is very difficult to treat and is unsatisfactory in many ways for treating. Some men claim that a green wood makes the best paving block. That is something we cannot very well do anything with. There may be some further developments in the industry that would enable us to write specifications covering just that point, but at present I do not see how we can do it.

(*Motion carried.*)

The President: We will hear now the report of the sub-committee on Concrete Paving, Mr. F. R. Charles, Chairman.

REPORT OF SUB-COMMITTEE ON CONCRETE PAVING

The sub-committee on concrete paving specifications presents for consideration the following report.

In preparing the specifications presented, we have used largely the corresponding specifications adopted by the Association for Standardizing Paving Specifications, changing the arrangement somewhat, and introducing a few additions.

It was thought well to include a method of ascertaining the suitability of sand for use in concrete by comparing mortar made thereof with similar mortar made from standard Ottawa sand.

We have included specifications for both single and two-course sidewalks and roadways, feeling that both kinds have a field of usefulness.

We understand that pavements having a concrete base with bituminated wearing surface are not included under the duties of this committee.

The question of joints in roadway paving is still under discussion. Mr. L. W. Page and several others maintain that no joints are necessary. This committee however, in view of present experience, is unwilling to recommend a construction without joints, although recognizing the fact that an absolutely satisfactory method of dealing with these joints is difficult to obtain.

FRED. R. CHARLES, *Chairman.*
F. D. BROWN,
C. G. ANDERSON.

SPECIFICATIONS FOR CONCRETE PAVEMENT, CEMENT SIDEWALKS, AND CONCRETE CURB AND GUTTER

When for any reason it is deemed desirable to use a concrete pavement instead of one of the standard forms of pavement, the following specifications are recommended.

THE CONCRETE

The concrete to be used shall consist of Portland cement, fine aggregate or sand, coarse aggregate and water, mixed in the required proportions.

Cement

The Portland cement to be used shall meet the requirements of the standard specifications for Portland cement of the American Society for Testing Materials (adopted August 16, 1909), with Section 21 amended to read as follows:

	Strength lbs. per sq. in. Neat
24 hours in moist air	175
7 days (1 in moist air, 6 in water)	500
28 days (1 in moist air, 27 in water)	600

Provided, however, if the cement fails to meet the requirements of the twenty-four hour test, it may, at the discretion of the engineer, be held for further tests, before being rejected, with the mixture of 1 cement to 3 standard Ottawa sand. In no case shall the increase in strength at twenty-eight days be less than 20 per cent over the strength shown at seven days.

All tests on cement to be used shall be made in accordance with the methods recommended in the report of the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, presented at the annual meeting January 12, 1911, with subsequent amendments.

Fine Aggregate

The fine aggregate shall consist of any material of siliceous, granitic or igneous origin, which shall contain less than 5 per cent of mica, and shall not contain, in any one cubic inch as taken from the pile, more than 7 per cent of clay, silt, vegetable debris or other harmful impurities.

For the foundation, the aggregate shall be uniformly graded in sizes ranging from ¼-inch diameter down to that which will be retained on a number 100 standard sieve, not more than 20 per cent of such aggregate to pass a number 50 standard sieve.

For the top coat, or wearing surface, the aggregate shall be uniformly graded in sizes ranging from ¼-inch diameter down to that which will pass a number 80 standard sieve, not more than 10 per cent of such aggregate to pass a number 50 standard sieve.

When mixed with Portland cement in the proportions of 1 part of cement to 3 parts of aggregate, and formed into briquettes in accordance with standard methods, the resulting mortar shall develop a tensile strength of at least 70 per cent of the strength of the mortar made of the same cement and the same proportions of standard Ottawa sand.

Coarse Aggregate

The coarse aggregate shall be clean, sharp and sound gravel, broken stone, or crushed slag, having a specific gravity of not less than 2.6. It shall be free from all dirt, vegetable matter and other foreign substances, uniformly graded in sizes ranging from ½ the thickness of the concrete down to that which will be retained on a screen having 4 meshes to the linear inch.

Water

The water to be used in mixing the concrete shall be clean and free from oil, acid, alkali or other injurious matter.

Mixing

The ingredients of the concrete shall be thoroughly mixed, then sufficient water added to obtain the desired consistency, and the mixing continued until all the ingredients are uniformly distributed in the mass, and each particle of the fine aggregate is thoroughly coated with cement, and each particle of the coarse aggregate is thoroughly coated with mortar.

If a mechanical mixer is used, the materials must be proportioned dry, and then deposited in the mixer all at the same time; the water then to be added, and the mixing continued until the concrete produced is of uniform consistency, with all the ingredients uniformly deposited, and each particle of the fine aggregate is thoroughly coated with cement, and each particle of the coarse aggregate is thoroughly coated with mortar.

Consistency

The ingredients of the concrete shall be so mixed as to produce a mass homogeneous in character, and uniform in color and texture, and of such consistency that water will flush to the surface under tamping without separating the cement and the aggregate.

Re-tempering

The re-tempering or re-mixing of mortar or concrete with additional water after the concrete has partially hardened will not be permitted.

Placing concrete

The concrete shall be deposited on the subgrade in such quantities that, after being thoroughly tamped in place, it will be of the required thickness, and the upper surface shall be true, uniform and parallel with the surface of the finished pavement. The conveying of the concrete from the place of mixing to the place of deposit must be conducted in such a manner that no mortar will be lost and the concrete must be so handled that when placed in the foundation it will be uniform in composition throughout, showing no excess nor lack of mortar in any place.

If the concrete be transported by wagons or carts from a central mixing plant, the length of the haul shall be so adjusted and the wagons so operated that the coarser particles of the aggregate will not be segregated from the smaller particles of the concrete.

Protection

Mixing concrete during freezing weather will not be permitted, and in no case shall any frozen material be used. In no event shall concrete be laid on a frozen foundation.

When completed, the concrete shall be kept moist for four (4) days, and shall be protected against freezing and excessive heat until the cement has thoroughly set.

CONCRETE SIDEWALKS

TWO COURSE WORK

Ingredients for concrete

The ingredients to be used shall comply with the preceding specifications for cement, coarse and fine aggregate, and water.

Proportions for base

In preparing concrete for base in two course work the cement and aggregates shall be mixed separately, and then mixed in such proportions that the resulting concrete shall contain fine aggregate to the amount of one-half the volume of the coarse aggregate, and so that 5½ cubic feet of concrete in place shall contain 94 pounds of cement.

Thickness

The base shall be . . . inches in thickness, with the upper surface parallel to and . . . inch below the grade of the finished sidewalks. (*The minimum thickness for base shall be 3 inches*).

Forms

The concrete shall be placed in forms which shall be smooth, free from warp, of sufficient strength to retain a true alignment, and of a depth to conform with the thickness of the walk, and shall be securely anchored. All mortar and dirt shall be removed from forms that have been previously used.

The forms shall be well staked, thoroughly braced, and set to the established lines; the upper edges conforming to the grade of the finished walk, which shall have sufficient fall from the lot line towards the curb line to provide for drainage, but said fall shall not exceed ⅜ inch per foot.

The base shall be blocked out in sections, in no case to exceed 6 feet in any dimension. The separation of adjacent sections shall be made by cross forms of ¼ inch metal of a depth to correspond with the thickness of the proposed walk, extending the full width of the walk, and set at right angles to the side forms. They shall be left in place until the wearing surface has been floated.

Wearing surface

The top course or wearing surface shall be composed of 1 part Portland cement and 2 parts fine aggregate, mixed with sufficient water to produce a mortar of a consistency which will not require tamping, but can easily be spread into position with a straight edge. This mortar shall be mixed in a mortar box, and shall be spread on the base immediately after mixing, levelled off and trowelled down thoroughly to insure a perfect contact. In no case shall the wearing surface be placed after the cement in the concrete base has set.

After the wearing surface has been worked to an approximately true plane, the sections or slab markings shall be made directly over the joints in the base. Such markings shall be made with a tool which will cut entirely through and completely separate the surface of adjacent slabs.

The top coat shall be trowelled to a uniformly even surface, and the top edges shall be rounded on all sides to a radius of about ½ inch.

The wearing surface shall be . . . inches in thickness. (*The minimum thickness of wearing surface shall be ½ inch.*)

The application of neat cement to the surface in order to absorb excess water or to hasten hardening is prohibited.

Protection

When completed the walk shall be kept moist and protected from traffic and the elements for at least three days.

ONE COURSE CONCRETE WALKS

The concrete to be used shall be proportioned so as to contain fine aggregate to the amount of one-half the volume of coarse aggregate, and so that 4½ cubic feet of concrete in place shall contain 94 pounds of cement.

Consistency

Sufficient water shall be used in mixing the ingredients to make concrete of such consistency that, when tamped with a grate tamper, the fine material will rise to the surface.

Finishing

After the surface has been so tamped, it shall be finished with float or trowelled to a true plane having an even surface. (*All general requirements same as heretofore specified.*)

CONCRETE CURB AND GUTTER

(The specifications for concrete curb and gutter are identical with above specifications for concrete walks, except as to the following items):

Forms

The back forms for curb shall be of a depth equal to the depth of the exposed face of curb plus the thickness of the pavement and the base. The face forms for gutter shall have a depth equal to the thickness of the wearing surface above the concrete foundation, if the material to be used for the pavement is other than concrete, and in no case shall the thickness of the gutter be less than 6 inches. The curb and gutter shall be divided into sections not to exceed 8 feet in length.

Wearing surface

The wearing surface for the face of the curb shall be placed on the inside of the face forms as the curb is built up, if two course work is used, and shall be . . . inches in thickness for both face of the curb and surface of the gutter.

For one-course work the face of the curb may be lightly plastered with Portland cement mortar to fill surface irregularities, provided such plaster is applied before the cement in the body of the curb has set.

Protection

The finished work shall be kept moist and protected against the elements for four days and protected from traffic for at least ten days.

CONCRETE ROADWAY

TWO COURSE WORK

Base

The cement and aggregates shall be mixed in such proportions that the resulting concrete shall contain fine aggregate amounting to one-half the volume of the coarse aggregate, and so that 5 cubic feet of concrete in place shall contain 94 pounds of cement.

The thickness of the base shall be . . . inches. (*The minimum thickness shall be 5 inches.*)

The concrete shall be placed and tamped so that all voids are filled and moisture rises to the surface. The surface shall be fairly true to grade and cross section, and left at a uniform depth of . . . inches below the finished surface of the roadway.

(*The balance of the specifications for concrete base to be the same as heretofore given, except as may be hereinafter provided for expansion joints.*)

Wearing surface

The top coat or wearing surface shall be composed of 1 part of Portland cement and 2 parts of fine aggregate mixed with water in sufficient quantities to produce a mortar of such consistency that it will not require tamping, and can easily be spread into position with a templet or straight edge.

(*The balance of the specifications for wearing surface the same as heretofore given for sidewalks, except that the surface shall be "raised with a cork or wood float" to give it a rough surface*).

The thickness of the concrete wearing surface shall be . . . inches. (*The minimum thickness for the wearing surface shall be 1 inch.*)

ONE COURSE WORK

For roadways of one course concrete, the cement and aggregate shall be so proportioned that the resulting concrete shall contain fine aggregate to the amount of one-half the volume of the coarse aggregate, and so that 4 cubic feet of concrete in place shall contain 94 pounds of cement.

Sufficient water shall be used to make a wet concrete. It shall be placed and tamped with a grated or barred tamper so as to bring the fine material to the surface. The surface shall then be finished with a trowel and floated as above specified for two course work.

The thickness of the pavement shall be . . . inches. (*The minimum thickness shall be 5½ inches.*)

Provisions for lateral expansion

If curb be used, a longitudinal joint with a full and clear width of at least 1 inch shall be left between the curb and the concrete roadway. The joint shall be filled to the full depth of the pavement with creosoted soft wood timber with grain vertical, or with suitable asphalt or other elastic water proof filler that will not become soft so as to flow in warm weather, nor become hard and brittle in cold weather.

No other longitudinal joint shall be used.

Provisions for longitudinal expansion

Cross joints shall be made to the full depth of the pavement at right angles to the curb, and at intervals not to exceed 50 feet. If wide joints are used they shall not be less than 1 inch in clear width, and the edges thereof shall be protected by a vertical metal plate, cut to fit the crown of the street.

These joints shall be filled to the full depth of the pavement with creosoted soft wood timber, with grain vertical, or with asphalt or other suitable elastic water proof filler that will not become soft so as to flow in warm weather, nor become hard and brittle in cold weather.

If the joints are not to have protection on the edges, they shall be not more than ¼ inch in width, and the edges of the concrete shall be rounded with a jointer having as small a radius as possible, not to exceed ¼ inch.

Protection

All concrete pavements shall be kept moist and protected from the elements for four days, and protected against traffic for at least ten days after being laid.

MR. FISHER: In this specification of fine aggregate the committee was of the opinion that it should not read "free from clay", because it would be almost impossible to get that, and a small amount of clay, not exceeding 7 per cent, if distributed, would not be objectionable.

(*Mr. Christ assumes chair.*)

MR. HALLOCK: I would like to hear some discussion on the percentage of loam permissible in the sand used in making this mixture, whether we can afford to fix a maximum and recommend that loam be permitted up to this maximum; and also whether a small percentage of loam in the sand gives better results than sand free from loam. I would like also to call attention to the provision in these specifications that specifications for concrete curb and gutter shall be the same as specifications for concrete sidewalk. In the specifications for sidewalk they fix a maximum of 8 feet in length for the section. In concrete curb and gutter we have used a 10-foot length, and find it satisfactory, and it makes a difference in the contractor's bid whether you specify a 10-foot length rather than 8-foot. An 8-foot length requires more metal divisions and a considerably larger outlay on a large piece of work.

Mr. Christ: In our specifications we have not less than 4 feet or more than 6 feet in the curbing. I see no reason why they cannot be made 10 feet long, except for the settling of the foundation. They might crack before setting, if you take the form off.

Mr. Hallock: That would apply to an 8-foot length as well as a ten. This makes the same specification, 8-foot length, apply to curbing and gutter. I am speaking of concrete curb and gutter combined, especially where they are reinforced.

Mr. Christ: We do not lay any over 6 feet. I was referring to sidewalks.

Mr. Fisher: Another fact we took notice of was the question whether a concrete pavement was the proper kind of pavement at all. I personally would not use it.

Mr. Anderson: As I understand it, our purpose is to fix approximately standard specifications for first-class structures. If the term "first-class" applies to pavements as a whole, it is one thing; if to concrete pavements, that is another thing. If it applies to pavements as a whole, I am placed in the situation of an alderman who was put in a tight place and he recorded his vote this way—"I vote for this measure, but under protest." If it applies to concrete pavements, I am in accord with the balance of the committee. Personally, I would not recommend concrete as a first-class pavement, but there are places where it may be used to advantage.

MR. NICHOLSON: I think the adoption of that specification is all right. It is not an expression of whether you think that is the best thing for the city to use. What we want to recommend is the best thing of its kind. We do not say concrete pavement is better than any other, but that this is the best form of concrete pavement. If you are going to use concrete pavement, this is the best form. There are many places where concrete pavement can be used with good results,—for instance, in alleys. We may find a way to build a concrete pavement successfully that all of us would agree to.

The selection of a pavement has as much to do with its success as the pavement itself. I have in mind the injudicious use of a wood block pavement on a residence street with no traffic. The result was bad. If you drew results from that, you would say a wood block pavement *per se* is no good, but that is not a proper conclusion. So if a man wants to put in a concrete pavement, that is the best form to build it. They must exercise their judgment with reference to putting in the form of pavement. I do not know whether we have recommended any of those bituminous binder pavements, but the other society did. Some cities will not use them, but there are places where they are of some use, and if they are going to build them, let us regulate the building of them, so that there will be no faulty construction.

MR. CHRIST: For courts and short streets it may be all right, but I have never seen a good concrete pavement on a street. It might be well to say that the committee does not recommend them for streets.

MR. HUGHES: The specifications refer to concrete curb and gutter combined. I have had a good deal of trouble with them and have seen trouble with them in other places. In places like a boulevard or graveled road, or something like that, a combined curb and gutter makes a nice appearance; but in a heavy traffic street you always find it worn in ruts next to the pavement proper of the street, and there are many reasons why that happens. Perhaps there should be some mention of that point so as to give the members the benefit of other men's experience, where this construction would be good business judgment.

In building a concrete curb and gutter I find some of these reasons for the gutter being bad: The contractor takes off some of the surface of the street with a grading gang. Then he puts a gang to work to build the curb and gutter. Behind them come the wheeled scrapers, to clean out the balance of the dirt and they hit this curb and jar it up before it gets set. Then the concrete carts come in and they do the same thing. This all is perhaps within two weeks or a few days. After that come the top carts and wagons and put on the asphalt or bitulithic or brick, and then they come along with a 5 or 10-ton roller and it rolls on the edge of this concrete gutter. It may not break, it may not be visible, it may look all right, but within a year you will find some of those pieces where the crystalization has been jarred at the wrong time, and there will be little cracks, and it will chip away and you have a hole there.

Mr. Van Zuben: Is there any definite opinion as to the width of the concrete gutter?

Mr. Christ: We put in a great deal of combination curb and gutter, but on water gravel or water macadam we put in 24 inches of gutter in connection with the curb, and outside of that a few rows of paving brick. Our gutters and curbs are constructed in first-class shape and we have had no trouble with their cracking. As to the contractor coming along, we have a clause that protects the curb for two years, and if he breaks anything he takes it up and puts in a new one, and they are careful.

Mr. Hughes: We make the contractor take out some also; but on certain streets, where the connection is between the gutter and the street proper, that is a wearing point, because it is generally where one wheel of the wagon runs. The result has been in many streets that we have cut out the curb altogether and put in brick.

Mr. Anderson: As to the permissible maximum allowance of clay or loam, we have thought the safest way is to require that the gravel be free from clay or loam because the specifications, as drawn, practically require the screening or washing of the gravel. Consequently the occurrence of that clay or loam may cause actual injury. It depends probably on the distribution of that impurity through the gravel. If it is well distributed maybe there is no harm; if it is in bunches, it may cause harm.

MR. HALLOCK: There has been advanced recently the statement that not only the clay loam is not dangerous to use, but that it is beneficial that a certain amount be allowed in the sand; that it aids in the setting. That is what I wanted to find out, whether any benefit was derived by allowing, say five per cent.

MR. FISHER: We allow 7 per cent in our specification, which was made many years ago by Emil Kuichling, whom I consider one of the most eminent engineers in matters of that sort in the country. We have followed that specification since. It is almost impossible to get sand absolutely free. Property owners on a street we were paving this summer raised the complaint about the quality of sand being used in the concrete. I had the paving engineer go there especially two or three times, and they showed him what they thought was bad, and he said it was good. I told them I should take his word sooner than theirs, because he knew and they did not, but one of them finally brought in some of the material. I said I thought it was pretty fair, and I asked him to let me send it over to the laboratory, but he said he would take it to the mayor. He took it down and brought it back, and I sent it to the laboratory. The young man who made the test knew nothing about where it came from. He mixed up four briquettes of this sand and four of what they use for standard sand. Our specifications require that the mortar made up with sand taken from the street shall stand at not less than 70 percent of the strength of mortar made with our standard sand, and the standard sand is limited to a minimum of 150. He made up those four briquettes; first testing the sand for loam and clay and finding about 10 per cent, something over 3 per cent more than we allowed. On testing at the end of seven days, the standard briquettes stood at something like 200 pounds, and those made up of that sand that the property owners said was not good, at 219. Our experience has been that this amount of clay, if properly distributed, does not hurt the mortar. If it was properly distributed, as in this case, it aids.

Mr. Nicholson: Was that clay or loam?

Mr. Fisher: It was fine material that we were not able to distinguish as clay or loam. There was some clay in it.

Mr. Nicholson: The nature of that material would have a great deal to do with it.

Mr. Anderson: About a year ago a certain contractor complained because we rejected certain sand. He said that engineers say 5 to 10 per cent is a good thing. If we had been working under that clause, we might have had some difficulty with him. The sand did not contain over 7 per cent of clay, but it was not uniformly distributed. If the engineer finds it gives good results, this seems all right; but to provide as we do in this specification might be a little bit dangerous.

Mr. Christ: We do not take any particular measure, a cord or a foot, and so we could compel its distribution.

Mr. Howell: The specifications should, of course, prohibit the use of sands that contain chunks of clay or loam. We have made some experiments in Newark along the lines of these tests stated by Mr. Fisher. When we took up the grouting of granite blocks some years ago, Mr. Owen, past president of this society, suggested to me that a very small proportion, not exceeding five per cent, of loam or clay as a binder was a good thing. About three years ago we started the paving of a street, an important highway carrying considerable traffic, and we wanted to be sure of the durability of our grouting. We made a large number of tests of sand with no loam or clay, and also of sands containing a small proportion, not exceeding 5 or 6 per cent, and in every test the mixture containing the small proportion of loam exceeded in strength the other. So there would seem to be some potency in this small percentage of loam.

Mr. Myers: About ten years ago the University of Kansas made a very elaborate set of tests along this line, and their results were almost precisely the same as here reported, namely, not exceeding 10 per cent of well distributed evenly powdered loam or clay adds to the strength of the concrete. If you will write to the dean of the scientific school at Lawrence, Kansas, you can get a copy of that report.

You specify an inch joint along each curb in those specifications. I am putting in a number, and use no expansion joints. My concrete, I find, is strong enough to hold its own against expansion. The only thing I have to provide for is contraction, and I put in transverse contraction joints ever twenty feet. I had a conference with Mr. McIntyre, the engineer for the Association of Cement Manufacturers, and that has been his experience over a number of jobs through the country. We are getting good results.

Mr. Nicholson: How do you make it?

Mr. Myers: I use a thin plate such as is used for sidewalk construction, and draw it. I would have a paper joint, but I find I can make more progress by using this method with a ¼-inch templet, and fill these joints with asphalt to protect the edges.

Mr. Noble: This matter of clay depends entirely on distribution. If the sand is from the river and is dirty from the water, t will not hurt it if you put it in the mixer and run it long enough, —the river water has rubbed the clay from the gravel. But if you take it from the bank, where the dirt had lain in contact with the gravel and was sticking to the sand, I do not believe you could rub that off with the mixing, and there it would be dangerous.

Mr. Parmley: The question of the absolute presence or absence of the clay has been discussed, but there is a cause lying back of that. I agree that a small percentage of clay is not detrimental, but adds somewhat to the strength of the concrete, if it does not exceed 5 per cent or thereabouts. But my observation has led me to the conclusion that the effect of clay has two phases to it. One is the effect of the clay as introducing a substance in the concrete that has some chemical action in the hardening of the concrete. The other is that, where you get the cleanest sand that has been subjected to the action of water as in rivers and lakes, where water separation carried to a considerable extent has produced a clean sand, you nearly always have a more or less uniform sand grain, and the farther water transports it, the finer it will be. Along the Great Lakes we get a very beautiful sand, apparently, for concrete work; but when you examine the sand grains you find they are uniform in size and that does not make as strong concrete as a rougher sand coming out of the banks. It was a long time before I could be convinced that dirty looking bank sand was better than clean sand, but it is so.

Mr. Christ: I believe the government allows 10 per cent of clay and loam.

Mr. Colby: Out of some twenty odd experiments we made in our laboratory, I found that in every instance clay and loam up to 7 per cent increased the strength, when properly disseminated. It would be more injurious if it were dirt or clay that adhered to the rock, or anything that created a film or separation.

Mr. Curless: In the western states, Washington, Idaho and Oregon, we have a volcanic ash. It is a fine powder. We made some experiments on pipe by adding 10 per cent of that to our mixture, and we got denser, stronger pipe than with ordinary cement and sand.

Mr. Dow: I have experimented largely with sand and have found that up to 12 per cent of clay increases the strength, and I believe it is a well known fact, as you all seem to have had that experience. You will find many articles on that subject in the engineering papers. Any evenly divided siliceous material of that sort will increase the strength of Portland cement. It would appear that the increase in strength is due to the presence of hydrate of silicates, which are very much more readily acted upon by the limes in the cement than the plain silica of the sand.

The Secretary: The objection advanced is that engineers will not be able to keep out *particles* of clay. Would it not remove that objection if we changed that to read that no sand in quantities of one cubic inch or less shall contain more then seven per cent of clay. If you take a small box and dip it in the sand, and do not get more than 7 per cent of clay, you have your clay pretty well distributed through the sand.

Mr. Dow: Would it not be well to specify the testing of the sand that is to be used?

The Secretary: When you take your sand to be tested in the laboratory, that sand gets mixed up and pounded, and if there are any clay particles there, by the time they get through with them in the laboratory they are mixed up with the sand, and it is possible the laboratory experiment might not meet that point. Could we make it read: "shall not contain more than 7 per cent of clay in any 1 cubic inch as taken from the pile." I will move that it be amended in that way.

(*Motion seconded by Mr. Myers and carried.*)

Mr. Christ: The next point is as to changing the length of blocks of sidewalk to 6 instead of 8 feet.

The Secretary: If you have a 4-foot walk, you can make a 4-foot block; if a 5-foot walk, a 5-foot block; or if a 6-foot walk, a 6-foot block, but if you take a 7-foot block you are getting blocks too large. If you have a walk 7 feet wide, you had better split that and put in two 3½-foot blocks.

Mr. Iredell: I have had experience with combined curb and gutter and sidewalk, and I believe it is better for appearance sake to cut the curb at the same place as the sidewalk.

Mr. Ewart: Throughout the far West we make sidewalks in 2-foot blocks, in 2-foot squares, and every 20 feet an expansion joint. We have found that a very successful method, as the blocks are easily removed, if broken.

Mr. Hallock: I move the maximum be made 6-feet in width instead of eight, as in the specifications.

(*Motion seconded by Mr. Nicholson and carried.*)

Mr. Christ: The next question is that of a smooth surface on sidewalks,—"troweled to a smooth surface." We do not finish them to a smooth surface; we rough them, either with a wood float or a brush. When troweled to a smooth surface they become very slippery.

Mr. Hallock: That would be difficult to specify for all latitudes and grades. I can recall several cities where, on level walks on streets running east and west, they require the walks to be troweled smooth, but on streets running north and south where the sun doesn't strike the walk a great deal, or where there is a 3 or 4 per cent grade, they require them to be rough. I doubt the wisdom of specifying either one.

Mr. Nicholson: Conditions are so different you cannot lay down a hard and fast rule. A smooth surface would be dangerous in one place and safe in another. That is a matter of judgment.

Mr. Anderson: Could not that be made to read: "A uniformly even surface?"

Mr. Christ: If there are no objections, the specifications will be so changed.

Mr. Noble: If you require a man to furnish a curb form every 5 feet, there is a good deal of cost. We furnish a form every 10 feet, and then allow them to mark it half way for 5 feet. We have never had any trouble with breaking or expansion or anything else, and I like them.

Mr. Christ: We use a 16-foot 2 inch plank for backing in front of the curb, and we saw in the top a place for the templet to hang in. It is easier to construct a curb in 16-foot lengths than 10.

Mr. Noble: But you use a continuous plank, anyhow?

Mr. Christ: Yes, it is just a matter of hanging the templet in this form.

Mr. Hallock: No, that is not the only difference. The great difference is going to be in the cost of your curb. If your contractor has a large force, he will lay 500 or 600 feet a day, and it will make a difference in the number of steel templets he has to keep on hand, and the braces, etc., and his bid will be higher for a 6-foot length than a 10-foot. They threatened to run the cost up 3 cents a foot on me if I changed the length of the curb.

Mr. Reimer: I am now arranging to construct the gutter and pave the street simultaneously, without any joint except the joints 20 feet apart, the same as I do my roadway proper. The joints are your weakest place, and the fewer you have the better you are off.

Mr. Christ: If you do that, someone may pile material back of the curb, and a rain will come along and settle it, and push it out, and it might break the curb if it is in such long lengths.

Mr. Ewart: Our concrete base is built 2 feet wider than the width of the street, and the curb and gutter are built on top of the base, the same as the pavement. If anything settles, it must all settle together. We use almost always armored curb, and we make it in 10-foot lengths because that is the length of the bar. That is our practice on a business street.

Mr. Christ: We do not put any foundation under the curb, unless it is soil that will not drain well.

Mr. Hallock: We have just adopted a 6-foot maximum for side-walks, which would made it a 6-foot maximum for curb and gutter. I therefore move that the maximum for curb and gutter be made 8 feet.

Mr. Noble: I will second that.
(*Motion duly carried.*)

Mr. Christ: The next is as to whether we shall adopt specifications for concrete pavement.

Mr. Colby: I have frequently stated in my practice that I would not recommend a certain thing, and I do not think I could be induced to recommend concrete pavement; except that in short streets, considering all the factors that enter into the case, initial cost and benefit to be derived, I might recommend it, and in my judgment it is proper for the society to adopt specifications that would cover concrete pavement, as long as we do not stand sponsor for the proposition that they are the best pavement.

Mr. Hallock: It would be unwise for us to say that concrete pavements are worthless in all places and under all conditions. Some localities demand the best form of cheap pavement that the engineer can devise, and it is possible that concrete pavement is the best pavement to fill that demand, and it is our duty to prepare the best specifications for concrete pavement. We do not necessarily endorse this pavement. We simply say, if you wish concrete pavement, this is the best specification you can use.

Mr. Fisher: One of the objections to making these specifications and sending them out to the different cities and towns, is that the officials do not always discriminate. If there was some way this matter could go out from the society so that the average city official who gets it would understand that the society did not endorse this as a pavement for a street, but would permit it for use in alleys or places where there was a small amount of traffic, I think it would be all right.

Mr. Christ: I believe the society should prepare specifications for water bound macadam as well as a gravel street, and then have something attached, that we do not recommend this as first class pavement.

Mr. Anderson: How would it do to preface the specifications as to concrete pavement by a statement that where it is found not desirable to use one of the standard forms of pavement, and where concrete is found desirable, the following specifications shall prevail.

The Secretary: We might preface the whole specification with an introductory note that would cover this.

Mr. Myers: I move we have the committee prepare something along that line.
(*Motion seconded by Mr. Fisher and carried.*)

Mr. Iredell: I move that the specifications, with the amendments made, be adopted as a whole.

Mr. Myers: I second that.

Mr. Iredell: I think the matter of expansion and contraction joints is important. We find in our sidewalk work that expansion joints are necessary. If you do not put them in, they come together on the cut joints, and shove up. I think we would have the same trouble on street pavements. We had some alley concrete pavement, and I specified expansion joints every 46 feet, and contraction joints every 23 feet. The reason for those distances is that they brought out the block practically even. I think a joint of some kind every 20 feet is desirable.

(*Motion duly carried.*)

The Secretary: I move that the general committee on Standard Specifications be instructed to appoint for next year two sub-committees to prepare specifications, one for water bound maca-adam, telford and gravel, the other for stone block.

(*Motion seconded by Mr. Myers and carried.*)

Mr. Colby: I move the general committee make a recommendation as to the discharge of any of the sub-committees that they may consider have finished their labors.

(*Motion seconded by Mr. Reimer and carried.*)

THURSDAY NOVEMBER 14

MORNING SESSION

The convention was called to order by the President at 9.30 o'clock.

The President: We will first take up the report of the standard committee on Sewer Specifications.

Mr. Fisher: The general committee has examined this report, and in view of the high character and large experience of the men who made this report—Mr. Fort, chief engineer of sewers in Brooklyn, Rudolph Hering, and Mr. Provost, we have felt we could not make any changes in it that would be of any value, and we recommend the adoption of the specifications as presented.

(*The secretary reads report, section by section.*)

SPECIFICATIONS FOR SEWER CONSTRUCTION

SUBMITTED BY SUB-COMMITTEE ON STANDARD SEWER SPECIFICATIONS

To be considered for final adoption at the 1913 convention

TRENCHES

Length of trench

1. Unless otherwise directed or permitted not more than . . . feet of any trench in advance of the end of the built sewer shall be open at any time; and unless written permission to the contrary is given, the trench shall be excavated to its full depth for a distance of at least . . . feet more than the minimum length of sewer permitted to be laid in it (see sections 152 and 158). Trenches for house connection drains shall not be open on both sides of the street at the same time, unless permission has previously been given to close the street. Unless otherwise directed, each trench for basin connections and house connection drains

shall be fully excavated for its entire length before any pipes are laid therein.

Sheeting and bracing

2. Where necesssary, the sides of the trenches and excavations shall be supported by adequate sheeting and bracing. Steel sheeting may be used only where shown on the plan or directed. Sheeting and bracing will be paid for only when left in place by written order, in which event the amount left in place will be paid for at the contract price for such material. Unless specially permitted, sheeting against which concrete is placed shall not be removed, but such sheeting will not be paid for unless ordered to be left in place to protect the sides of the trenches and excavations. The contractor will be held accountable and responsible for the sufficiency of all sheeting and bracing used, and for all damage to persons or property resulting from the improper quality, strength, placing, maintaining or removing of the same.

Sheeting in soft material

3. Where the material to be excavated is of such a character or other conditions are such as to render it necessary, the sheeting shall be closely driven and to such depth below the bottom of the sewer as may be directed.

Tunneling

4. All work shall be done in open trenches or excavations, no tunneling shall be done except with the consent of the engineer.

Trees and stumps

5. The contractor shall grub and clear the surface over the trenches and the excavations of all trees, stumps, stones, and any other incumbrances affecting the prosecution of the work, and shall remove them from the site.

Material to be disinfected

6. If required by the engineer, any or all of the excavated material shall be satisfactorily disinfected or deodorized or immediately removed from the work.

Roadway, sidwalks, etc., to be kept clear

7. Unless permission is given to the contrary, the excavated material and materials of construction shall be so deposited, and the work shall be so conducted as to leave open and free for pedestrian traffic all crosswalks, a space on each sidewalk not less than one-third the width of the sidewalk and not less than 3 feet in width, and for vehicular traffic a roadway not less than 8 feet in width. All street hydrants, water gates, fire alarm boxes and letter boxes shall be kept accessible for use. Not more than . . . linear feet of sidewalk shall be used at any time for storage of materials from any one trench. During the progress of the work the contractor shall maintain crosswalks, sidewalks and roadways in satisfactory condition, and the work shall at all times be so conducted as to cause a minimum of inconvenience to public travel, and to permit safe and convenient access to private and public property along the line of the work.

Surplus material

8. If all of the excavated material cannot be stored on the street in such a manner as to maintain the traffic conditions hereinbefore specified, the surplus shall be removed from the work and stored. After the construction of the sewer, so much of this material as is of satisfactory quality and necessary for the purpose shall be brought back and used for backfilling the trench.

Material from first . . . feet to be carted away

9. Where directed, in built-up districts and in streets where traffic conditions render it necessary, the material excavated from the first . . . feet of trenches shall be removed by the contractor as soon as excavated, and the material subsequently excavated, if suitable for the purpose, shall be used to backfill the trenches in which the sewers have been built, and neither the excavated material nor materials of construction shall be stored on the roadways or sidewalks.

Fence

10. Where required by the engineer, suitable fences shall be placed along the sides of the trenches to keep the streets safe for traffic.

Temporary bridges

11. Crosswalks, where intersected by trenches, shall if required be temporarily replaced by substantial timber bridges not less than 3 feet wide, with side railings. Where required, suitable temporary bridges for vehicles shall be provided and maintained across trenches.

Disposal of water from trenches

12. The contractor shall at all times during the progress of the work keep the trenches and excavations free from water. Water from the trenches and excavations shall be disposed of in such a manner as will not cause injury to the public health, nor to public or private property, nor to the work completed or in progress, nor to the surface of the streets, not cause any interference with the use of the same by the public.

Cost to be covered

13. The cost of all labor required to be done and all materials required to be furnished in the performance of all of the work specified in paragraphs 1 to 12 inclusive, except as otherwise provided, shall be covered by all the contract prices for all the items for which there are contract prices.

EARTH EXCAVATION

14. Earth excavation shall include the removal of all material other than rock as defined in sections 21 and 22.

Width of trench for sewers, etc.

15. The minimum widths of trenches in earth for pipe sewers, basin connections, house connection and other drains not over 18 inches in diameter, shall be such as to give a clearance of 8 inches on each side of the barrel of the pipe, and for those of larger diameters of 10 inches on each side of the barrel of the pipe, and all such trenches shall have a clear width equal to the maximum widths of the cradles of the sewers to be laid in them, when such cradles are wider than the minimum widths hereinbefore specified. The minimum clear widths of trenches in earth for other

sewers shall be the greatest external width of the structures, including the necessary forms, to be built therein.

Excavation for manholes, etc.

16. Where a riser, manhole or other appurtenance or the foundation therefor extends beyond the exterior lines of the sewer or its foundation, the minimum excavation in earth required for the same shall be that contained in a prism with vertical sides and a horizontal section equal to the smallest rectangle which will enclose such appurtenance and its foundation.

Excavation for receiving basins, etc.

17. The minimum dimensions of the excavation in earth for receiving basins, catch basins and flush tanks shall be such as to give a clearance inside the sheeting of 1 foot on all sides, above the foundation, but in all such cases the excavation shall be large enough to include the foundation for the structures shown on the plan. The excavation for concrete catch basins and flush tanks shall be of such dimensions as to permit the proper placing and removal of the necessary forms.

Depth of trenches

18. Trenches shall be excavated to the depths required for the foundations of the sewers and appurtenances shown on the plan, and where conditions are such as to make it necessary, to such additional depths as may be directed. Where pipe is laid without a cradle, the bottoms of trenches shall be excavated to fit the lower third of the pipe, and excavations shall be made to receive the hubs. All irregularities in the bottoms of trenches shall be filled up to the required grade with suitable material.

Cost to be covered

19. The cost of all labor required to be done and all materials required to be furnished in the performance of all the work specified in paragraphs 14 to 18 inclusive, except as otherwise provided, shall be covered by all the contract prices for all the items for which there are contract prices.

Additional earth excavations

20. When there is a contract price for additional earth excavation, it shall cover the cost of excavating all material (other than rock) ordered to be excavated beyond the lines and depths herein specified in sections 15 to 18 inclusive, and also the cost of excavating all material within the lines of the trenches above the surface of the ground as shown on the plan, when such material has not been placed there by the contractor. This contract price shall also cover the cost of filling such excavations with approved material. Where no price is named in the contract for additional earth excavation, the cost of the several items enumerated above shall be covered by all the contract prices for all the items for which there are contract prices.

ROCK EXCAVATION

Definition

21. Rock excavation shall include the excavation and removal of the following materials:

a. Rock which shall be determined to be of such a character as to warrant its removal by blasting, in order to insure the prompt and proper prosecution of the work.

b. Boulders and pieces of rock, masonry in mortar, and concrete, each of which contains 1 cubic yard or more, except the masonry and concrete of old sewers and their appurtenances.

22. Pieces of rock, masonry, concrete or boulders which fall or slide into the trench from beyond the lines thereof as herein defined, will not be measured, and the cost of the removal of the same shall be covered by all the contract prices for all the items for which there are contract prices.

Width of trench

23. The required width of trench in rock for pipe sewers, basin connections, house connections and other pipes will be such as to give a clearance of 1 foot on each side of the pipe, exclusive of spurs and hubs, the required width of trench in rock for other sewers and drains will be such as to give a clearance of 1 foot on each side of the structure to be built therein at its greatest

external width. Where a riser, manhole or other appurtenance, or the foundation therefor, extends beyond the exterior lines of the sewer or its foundation, the excavation in rock required for the same will be that contained in a prism with vertical sides and a horizontal section 1 foot wider on each side than the smallest rectangle which will enclose such appurtenance and its foundation. The required dimensions of the excavation in rock for receiving basins, catch basins and flush tanks will be such as to give a clearance of 1 foot on all sides above their foundations.

Depth of trench

24. The rock shall be excavated to the depths required for the cradles and foundations of the structures as shown on the plan.

Measurement

25. The volume of rock to be paid for will be that contained in prisms with vertical sides and of such dimensions as to give the widths and clearances hereinbefore specified from the bottoms of the trenches, as specified, to the surface of the rock.

Rock stripped

26. Rock shall be stripped in sections which, unless otherwise permitted, shall be not less than 50 feet in length, and the engineer shall then be notified in order that he may measure the same. Rock excavated or blasted before such measurement is made will not be paid for.

Excavation for branches

27. Wherever a branch for a proposed sewer or extension of a sewer is built in rock, the required trench shall be excavated for a distance of not less than 5 feet beyond the end of such branch, in the direction of the proposed sewer or extension.

Blasting

28. All blasting operations shall be conducted in strict accordance with existing ordinances and regulations relative to rock blasting and the storage and use of explosives. Any rock excavation within 5 feet of a water main less than 36 inches in diame-

ter, and within 10 feet of a water main 36 inches or more in diameter, shall be done with very light charges of explosive, or, if directed, without blasting, and the utmost care shall be used to avoid breaking or disturbing the main.

Exposed structures to be protected

29. All exposed sewers, manholes, receiving basins and other structures shall be carefully protected from the effects of blasts. Any damage done to such structures shall be promptly repaired by the contractor at his own expense.

Price to cover

30. The contract price for rock excavation shall cover the cost of all labor and materials required to excavate and remove all rock as specified, and without regard to its subsequent use. When there is no contract price for rock excavation the cost of of excavating and removing rock shall be covered by all the contract prices for all the items for which there are contract prices.

BACKFILLING

Backfilling around sewers, etc.

31. Unless otherwise specified or directed, all trenches and excavations shall be backfilled immediately after the structures are built therein. For a depth of at least 2 feet over the top of sewers, basin connections, house connections and other drains, the material used for backfilling trenches as excavated shall be clean earth, sand or rock dust. It shall be carefully deposited in uniform layers not exceeding 6 inches in depth, and unless otherwise permitted each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work.

Backfilling for remainder of trench

32. Backfilling for the remainder of the trenches as excavated shall be approved material free from organic matter and containing no stones over 10 inches in their largest dimensions. Stones which are used in backfilling shall be so distributed through the

mass that all interstices are filled with fine material. Backfilling shall be deposited as directed, and unless otherwise permitted shall be spread in layers and solidly tamped.

Backfilling around manholes, receiving basins, etc.

33. Backfilling within 2 feet of manholes, house connection drains, receiving basins, inlet basins, flush tanks and other structures shall be of the same quality as that specified in sections 32 and 33. It shall be uniformly deposited on all sides and unless otherwise permitted solidly tamped in such a manner as to avoid injuring the structures or producing unequal pressures thereon.

Puddling

34. Backfilling shall, if required, be flooded or puddled with water as the work progresses, instead of being tamped.

Cavities filled

35. When sheeting is drawn, all cavities remaining in or adjoining the trench shall be solidly filled. When sheeting is left in place, all cavities behind such sheeting shall be solidly filled as directed.

Deficiency of filling

36. Unless otherwise shown on the plan, trenches shall be backfilled to the height of the surface of the ground as it existed at the commencement of the work. Should there be a deficiency of proper material for the purpose, the contractor shall furnish and place such additional material as may be required.

Temporary bulkheads

37. For retaining backfilling only temporary bulkheads will be allowed. Such bulkheads shall not be of stone, and they shall be removed as the trenches are backfilled.

Curves, branches, etc. not to be covered

38. Sewers built on curves, also drains, basin connections, house and sewer connections and intersections, ends of sewers and branches shall not be covered until the engineer shall have

inspected, measured and located the same, and given permission to backfill the trenches over them.

Removal of surplus material

39. As trenches are backfilled, the contractor shall remove all surplus material and regrade and leave free, clear and in good order all roadways and sidewalks to within . . . feet of the end of the completed work. During the progress of, and until the final payment for and acceptance of, the work, he shall maintain in good and safe condition the surface of the street over all trenches, and promptly fill all depressions over and adjacent to trenches caused by settlement of backfilling. In case of failure or neglect on the part of the contractor to comply with the requirements of this paragraph within 24 hours after the service upon him of a written notice so to do, the . . . may furnish all materials and do all work required, and the cost thereof will be charged to the contractor and deducted from any moneys due or to become due him under this contract. All surplus material or any part thereof shall, if required, be deposited as directed on the streets and avenues within the limits of this contract where surfaces are below grade, and in such a manner as to leave the surfaces of the filled material even.

Cost included

40. The cost of all labor required to be done and all materials required to be furnished in the performance of all the work specified in sections 31 to 39 inclusive, shall be covered by all the prices for the items for which prices are named in the contract.

CEMENT

Quality

41. All cement used in the work shall be high grade Portland cement of well-established and approved brands.

Specific gravity; weight

42. The cement shall have a specific gravity of not less than 3.10 after being thoroughly dried at 212° F. It shall weigh not less than 380 pounds net, to the barrel, 4 bags of 95 pounds each

being considered equivalent to a barrel. For the purpose of measurement one bag shall be considered as the equivalent of nine-tenths of a cubic foot.

Fineness

43. The cement shall be dry, finely ground, of uniform color and free from lumps. It shall leave a residue of not more than 8 per cent by weight when passed through a No. 100 sieve, and not more than 25 per cent when passed through a No. 200 sieve.

Tensile strength

44. Standard briquettes shall develop, within the periods specified, tensile strength not less than that shown in the following table:

Neat cement

	Lbs. per sq. in.
24 hours in moist air	175
7 days (1 day in moist air, 6 days in water)	500
28 days (1 day in moist air, 27 days in water)	600

Mortar consisting of 1 part cement and 3 parts of standard Ottawa sand, by weight

7 days (1 day in moist air, 6 days in water)	180
28 days (1 day in moist air, 27 days in water)	225

The average of the tensile strengths developed at each age by the briquettes in any set from one sample will be considered the strength of the sample at that age, excluding any results that are manifestly faulty. The average strength of briquettes at 28 days shall be greater than the average strength at 7 days, and if tests are made after 28 days the strength shall be not less than that at 28 days.

Soundness

45. Pats of neat cement, when tested for constancy of volume or soundness, shall remain firm and hard and show no sign of checking, cracking, distortion or disintegration.

Setting

46. Unless otherwise required, cement shall not develop initial set in less than 30 minutes, and shall develop final set in not less

than 1 hour nor more than 10 hours. Quick-setting cement of an approved brand shall, if required, be kept on the work in sufficient quantity to provide for any contingency requiring the use of the same.

Testing

47. Cement will be subjected to such tests as the engineer may deem necessary, and such tests will be made in accordance with the methods recommended by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers.

Retesting

48. Any cement which shall have been kept in storage after testing for a sufficient time to warrant it, shall be retested. Any prior acceptance shall be considered void and the acceptance or rejection of the cement shall depend upon the results of the latest tests.

Approval of brand may be rescinded

49. The engineer may at any time rescind the approval of any brand of cement that develops qualities which in his opinion unfit it for use in the work.

Samples

50. The contractor shall notify the engineer of the arrival of cement on the work, and furnish such facilities as may be required for obtaining samples for testing. Samples will be taken so as to fairly represent the material. The number of packages sampled and the quantity to be taken from each will depend upon the importance of the work and the number of tests to be made.

Delivery and storing

51. Cement shall be delivered on the work in barrels or approved bags of uniform size with the brand and the name of the manufacturer plainly marked thereon, and shall be immediately stored in a dry place and carefully protected from the weather. A sufficient stock of cement shall be kept on the work in advance of the necessity for its use to permit of the making of the required seven day tests. Except by written permission, no cement shall be used before it has been tested and accepted, and any concrete

or masonry which may have been made under such permission with cement that is subsequently rejected, shall be removed and replaced with concrete or masonry made of accepted cement. All cement found to be of improper or inferior quality shall be immediately removed from the site of the work.

Cost to be covered

52. The cost of furnishing, storing and incorporating cement in the work, and the cost of samples required for testing, shall be covered by the contract prices for the structures or classes of work in connection with which the cement is used.

MORTAR

Composition

53. All mortar used in the work, unless otherwise specified, shall be composed of 1 volume of cement, as in the original package, and 2 volumes of sand. Mortar used in the haunch walls of brick sewers shall be composed of 1 part cement and 3 volumes of sand.

Sand

54. The sand shall be clean and sharp, free from dirt, loam, mica and organic matter, and shall contain not more than 4 per cent by volume of clay, and no clay shall be artificially added.

Mixing

55. Mortar shall be mixed in a suitable box or on a tight platform, and never upon the ground. The cement and sand shall be thoroughly mixed dry, until the mixture has a uniform color. Clean, fresh water shall then be added and the mass worked until a mortar which is uniform and of the required consistency is produced. Mortar shall be mixed in no greater quantity than is required for the work in hand, and any that has set sufficiently to require retempering shall not be used.

Freezing weather

56. The mixing and use of mortar in freezing weather shall be subject to the same requirements as hereinafter specified for mixing and placing concrete under similar conditions.

Cost covered

57. The cost of all labor and materials required to furnish and place mortar in the work, as specified, shall be covered by the contract price for the structure or class of work in connection with which the mortar is used.

CONCRETE

Class A concrete

58. Class A concrete shall be made of 1 part of cement, 2 parts of sand and 4 parts of broken stone or gravel.

Broken stone for Class A concrete shall be hard, sound and durable and shall not contain loam, clay, organic matter, objectionable quantities of dust or other improper material. Broken stone for Class A concrete shall be the run of the crusher that will pass through a screen with circular openings 1, 1½ and 2 inches in diameter and be retained on a screen with openings ⅛ inch in diameter. Gravel shall be of hard sound durable material equal in quality to that specified for broken stone. It shall be clean and of the sizes herein specified for broken stone.

Class B concrete

59. Class B concrete shall be made of 1 part of cement, 2½ parts of sand and 5 parts of broken stone or gravel.

Broken stone, gravel and sand for Class B concrete shall in all respects comply with the requirements specified for the same materials for Class A concrete.

Class C concrete

60. Class C concrete shall be made of 1 part of cement, 3 parts of sand and 6 parts of broken stone or gravel. Broken stone for Class C concrete shall be the run of the crusher that will pass through a screen with circular openings 1, 1½ and 2 inches in diameter and be retained on a screen with circular openings ⅛ inch in diameter. Gravel for Class C concrete shall be as specified for Class A concrete.

Broken stone, gravel and sand for Class C concrete shall in all respects comply with the requirements for similar materials for Class A concrete except as to sizes as above specified.

Rubble concrete

61. Rubble concrete shall consist of Class B concrete with large stones embedded therein.

The embedded stones shall be hard, sound and durable, roughly cubical in shape and of such sizes as may be deemed suitable for the mass in which they are to be used. They shall be laid on their largest beds and be so placed in the work that they will not be nearer than 9 inches to the bottom of a footing, to an expansion joint, to any surface or to each other. The stones after having been thoroughly cleaned and wetted shall be firmly bedded in the concrete. The joints shall then be filled and the stones covered with concrete to such a depth that the spacing specified will be obtained. The stones shall not be placed directly on any concrete which has acquired its initial set.

Measuring ingredients

62. For the purpose of determining the proportions of the materials for concrete, each bag of cement will be considered as containing $\frac{9}{10}$ cubic foot, and the other ingredients shall be measured by an approved method.

Water

63. Only clean fresh water shall be used for concrete.

Mixing

64. Unless permitted to be mixed by hand, concrete shall be mixed in mechanical batch mixers, so constructed and operated that the ingredients of the concrete may be accurately measured and will be thoroughly mixed. Enough water shall be added during the mixing to bring the concrete to the required consistency, which generally shall be such that the concrete may be poured into place without causing the separation of the stones from the mortar. When concrete is mixed by hand the broken stone or gravel shall be thoroughly wet before it is used. The cement and sand shall be mixed in the proper proportions dry until the mixture has a uniform color. It shall then be made into mortar of the desired consistency. The broken stone shall be added and the entire mass turned until each stone is entirely coated with mortar.

Placing concrete

65. Concrete shall be mixed only in such quantity as is required for the work in hand, and any that has set sufficiently to require retempering shall not be used. Any concrete in which the water has separatd from the solid matter shall be satisfactorily remixed before being placed. The concrete shall be so deposited in the work as to prevent the separation of the stone from the mortar. It shall be deposited in as nearly a continuous operation as practicable and shall be worked, tamped, spaded or rammed with suitable tools to produce a dense and compact mass. When the operation of placing concrete is interrupted the concrete in the work shall, if required, be confined by suitable temporary forms or bulkheads. When concrete is to surround reinforcing rods, structural steel or wire netting, it shall be so deposited as to work closely around such material. When a comparatively dry concrete is used it shall be deposited in horizontal layers not exceeding 6 inches in depth and solidly tamped.

Joining old and new concrete

66. When fresh concrete is to be laid on or adjoining concrete already set, the surface of the latter shall be thoroughly cleaned, washed, and roughened, and coated with a grout of neat cement before the fresh concrete is deposited.

Forms and centers

67. The contractor shall provide all necessary forms and centers for shaping concrete wherever used. They shall be true to the required shapes and sizes, strong enough and so secured in place as to withstand all operations incidental to placing the concrete, and watertight, and the faces against which the concrete is to be placed shall be satisfactorily smooth and clean. When lumber is used in forms and centers for exposed faces it shall be of seasoned stock and shall be coated as directed with an approved lubricant.

Removal of forms and centers

68. Forms and centers shall be left in place until the concrete has set sufficiently to permit their removal without danger to the

structure, and until so much of the backfilling or embankment as may be directed has been put in place. No forms or centers shall be struck or removed until permission to do so has been given.

Exposed surfaces

69. Special care shall be used to secure smooth and uniform finish to the surfaces of concrete which will be exposed in the completed structure. Immediately after the removal of the forms such surfaces if uneven shall be rubbed smooth to a uniform and satisfactory finish. All exposed edges of concrete shall be neatly rounded as directed, and if any voids, projections or other imperfections be found, such defects shall at once be corrected by tooling, cutting out and filling with mortar, or otherwise, as directed.

Expansion joints

70. Expansion joints shall be provided in such manner and at such places as are shown on the plan or as may be directed. All unavoidable joints shall be made as shown on the plan or as directed.

Depositing concrete under water

71. Whenever it becomes necessary to place concrete under water, it shall be deposited by means of drop-bottom buckets, closed chutes or other approved method. Concrete so deposited shall be carefully spread without tamping.

Freezing weather

72. In freezing weather, until the temperature falls to 24° F. the water used for concrete shall, if directed, be heated to an approved temperature, and if directed, 1 per cent by weight of salt shall be added to the water for each degree Fahrenheit that the temperature of the air is below 32° F. Other materials for concrete shall be heated sufficiently to remove all frost and ice. No concrete shall be laid when the temperature of the air is below 24° F.

Protection

73. Concrete shall be allowed to set for such time as may be directed before it is worked or walked upon, or before backfilling

or other material is placed upon or against it. It shall not be flooded with water until it has sufficiently set. Concrete shall be carefully protected from injury by freezing and from the drying effects of the sun and wind by covering it with canvas, bagging, hay or other suitable and approved materials. Such protection shall be placed as soon as the concrete is in condition to receive it, and except in freezing weather, the covering as well as the concrete shall be kept wet for such time as may be directed.

Measurement

74. The amount of concrete to be paid for as such will be all concrete put in place as shown on the plan or as directed, except such concrete shown on the plan as parts of structures for which there are contract prices and the cost of which is hereinafter specified as covered by the contract prices for such structures.

Prices to cover

75. The contract prices for the various classes of concrete shall cover the cost of all labor and materials required to furnish, place and remove all necessary forms and centers, and to make, place and protect the concrete as specified.

BRICK MASONRY

Quality of bricks

76. All bricks used in the work shall be sound and hard burned throughout, and of uniform size and quality. If required, the bricks shall be culled immediately after they are brought on the work and all bricks which are warped, cracked or of improper size, shape or quality shall be at once removed. The proportion of bats permitted will be determined according to the character and location of the work in which they are to be used. When bricks are used for lining inverts and in neat arch courses of sewers they shall be specially selected and no bats shall be used except for closers.

Vitrified bricks

77. Where shown on the plan, vitrified bricks of approved size and quality shall be furnished and laid. After having been thor-

oughly dried and then immersed in water for 24 hours they shall not absorb more than 4 per cent of their weight of water.

How laid

78. Bricks shall be satisfactorily wet when being laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The joints shall be not wider than $\frac{3}{8}$ inch, except when the bricks are laid radially, in which case the narrowest part of the joint shall not exceed $\frac{1}{4}$ inch. The bricks shall be laid in a workmanlike manner, true to line, and wherever practicable the joints shall be carefully struck and pointed on the inside. Brickwork shall be laid with a satisfactory bond, and as it progresses shall be racked back in courses, unless otherwise permitted.

BRICKWORK

Protection

79. All fresh brickwork shall be carefully protected from freezing and from the drying effects of the sun and wind, and if required, it shall be sprinkled with water at such intervals and for such a time as may be directed. Brickwork shall be protected from injuries of all sorts, and all portions which may become damaged or may be found defective shall be repaired, or if directed, removed and rebuilt.

Freezing weather

80. In freezing weather bricks shall be heated sufficiently to remove all ice and frost.

Measurement

81. The amount of brick masonry to be paid for as such will be all brick masonry built, as shown on the plan or as directed, except such brick masonry shown on the plan as parts of structures for which there are contract prices and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

Price to cover

82. The contract price for brick masonry shall cover the cost of all labor and materials required to build and protect the same as specified.

CUT STONES

Materials

83. Where shown on the plan, cut stones of the required kind, form, dimensions and finish, shall be furnished and accurately set in full beds of mortar. The stones shall be sound, durable, and free from rifts, seams and laminations, and other imperfections.

Cost covered

84. The cost of all labor and materials required to furnish and set cut stones as specified shall be covered by the contract price for the structure or class of work in connection with which they are used.

CEMENTED RUBBLE MASONRY

Materials

85. Stones for rubble masonry shall be hard, sound, free from checks and shakes, as nearly rectangular as practicable, and unless used for trimming or closers, not less than 6 inches thick. The stones shall be cleaned and wetted immediately before being placed in the work; they shall be laid on their natural beds, in fullbeds and joints of mortar, with spalls firmly embedded therein. In walls, one-third of the stones shall be headers extending through the walls where the same do not exceed 3 feet in thickness.

How laid

85*a*. All rubble masonry laid in mortar shall be laid to line, thoroughly and satisfactorily bonded, and in courses roughly levelled up. When the laying of rubble masonry in mortar is interrupted the tops of the courses shall be left unplastered. No dressing or tooling shall be done on or upon any stone after it is in place. Immediately before any rubble masonry in mortar is laid on or against any such masonry in which the mortar has set, the surface of such masonry shall be thoroughly cleaned and wetted. Rubble masonry laid in mortar shall not be laid in freezing weather.

Pointing

86. When the faces of rubble masonry laid in mortar will be exposed to view in the finished work, the joints in such faces shall be raked out to a depth of not less than 1 inch and neatly pointed with mortar composed of 1 part cement and 2 parts sand.

Measurement

87. The amount of rubble masonry laid in mortar to be paid for as such will be all cemented rubble masonry built as shown on the plan or as directed, except such shown on the plan as being part of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

Price to cover

88. The contract price for cemented rubble masonry shall cover the cost of all labor and materials required to construct the same, as specified.

DRY RUBBLE MASONRY

How laid

89. Dry rubble masonry shall conform to the requirements specified in sections 85 and 87, except those that relate to the use of mortar. All joints shall be thoroughly pinned and wedged with suitable spalls.

Price to cover

90. The contract price for dry rubble masonry shall cover the cost of all labor and materials required to construct the same, as specified.

STONE BALLAST

Quality

91. Stone ballast shall be broken stone, clean, sound, hard and roughly cubical in shape and unless otherwise shown on the plan or directed, of sizes ranging from 1 inch to 4 inches. Cobbles, if satisfactory, may be used.

Price to cover

92. The contract price for stone ballast shall cover the cost of all labor and materials required to furnish and place the same as specified.

STRUCTURAL STEEL

Quality

93. All structural steel used shall be medium steel and rivet steel made by the open hearth process and shall conform to the latest revised Standard Specifications for Structural Steel for Buildings adopted by the American Society for Testing Materials, and such tests as may be required shall be made in accordance therewith and at the places hereinafter specified. The chemical and physical properties of the steel shall be as follows:

Properties considered	Medium steel	Rivet steel
Phosphorus (maximum)	0.06 per cent	0.06 per cent
Ultimate tensile strength, pounds per square inch	55,000—65,000	48,000—58,000
Yield point	½ ult. tens. str.	½ ult. tens. str.
Elongation, per cent in 8 inches (minimum)	$\frac{1,400,000}{\text{ult. tens. str.}}$	$\frac{1,400,000}{\text{ult. tens. str.}}$
Character of fracture	Silky	Silky
Cold bend without fracture	180° to diameter of 1 thickness	180° flat.

Finish

94. All finished material shall be free from injurious seams, flaws and cracks, and have a workmanlike finish.

Variation in weight

95. When steel is inspected at the mill or shop all pieces (except plates), which vary in weight more than 2½ per cent from that specified, shall be rejected, when steel is not inspected until it is delivered on the work such variation in weight will be sufficient cause for rejection when in the judgment of the engineer the safety of the work will be impaired thereby.

Workmanship

96. All structural steel shall be in accordance with the plan and approved shop drawings. All details not shown on the plan, and all workmanship and finish shall be equal to the best current practice in similar work for buildings.

Anchor bolts

97. Anchor bolts and expansion bolts shall be furnished where required and set in place as directed. When holes are drilled in masonry or concrete for such bolts, the holes shall be washed clean and the bolts shall be firmly embedded in a mortar composed of equal parts of cement and sand, unless other material is shown on the plan.

Melt numbers

98. Test specimens and every finished piece of steel shall be stamped with melt or blow number, except that small pieces may be shipped in bundles securely wired together, with the melt or blow number on a metal tag attached.

Tests and inspections

99. The required tests and inspections of structural steel shall, if directed, be made at the mills and shops by the city's authorized inspector. The contractor shall notify the engineer as to the mills and shops which are to supply the steel, sufficiently in advance to enable the engineer to arrange for such tests and inspections and the mills and shops shall afford every facility for making the same.

Mill certificates

100. If it is decided not to make the tests and inspections at the mills, then mill certificates showing the properties of each melt of which the steel is made will be accepted for consideration.

Shipping invoices

101. The contractor will be required to furnish complete copies of shipping invoices with each shipment of steel.

Certificates, etc. for information only

102. Steel will not be accepted until the required inspector's reports or mill certificates are received. All tests, inspection, reports and certificates are for the information of the engineer, and he shall not be precluded on account thereof from requiring or making any further tests which he may deem necessary.

Shop drawings

103. The contractor shall prepare complete and accurate shop drawings of all steel work, and no shop work shall be done until such drawings shall have been approved. The contractor shall furnish to the engineer 3 complete sets of prints of the approved shop drawings.

Painting

104. All steel shall be thoroughly cleaned of scale, rust, oil and dirt, and unless otherwise directed, those parts which are not to be bedded in concrete shall be painted with a priming coat of the best red lead and linseed oil or such other paint of equivalent value as may be directed. After erection, the metal which will be exposed in the finished work shall be evenly painted with 2 coats of approved paint. No painting shall be done on wet surfaces.

Measurement

105. The amount of structural steel paid for as such will be all structural steel placed in the work in accordance with the plan or directions, except any excess greater than 2½ per cent above the weight required, and except such structural steel shown on

the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

Price to cover

106. The contract price for structural steel shall cover the cost of all labor and materials required to furnish, fabricate, erect and paint the same, to furnish all test pieces, to prepare and furnish prints of shop drawings, and to drill holes for and set anchor and expansion bolts, where required, all as specified.

STEEL REINFORCEMENT BARS

Shape

107. Steel bars for reinforcing concrete shall be of such shape as to afford an approved mechanical bond with the concrete and to insure intimate contact between the steel and concrete. Plain bars may be used only when shown on the plan.

Samples

108. The contractor shall indicate the type of bars proposed to be used, and if required shall furnish samples thereof, and he is cautioned not to place the order for bars until the type has been approved.

Size

109. Each bar shall have a net cross sectional area equivalent to that designated on the plan or required, or it shall be the commercial size of the approved type of bar having a net cross sectional area next larger than that designated or required.

Variation in weight

110. Reinforcement bars will be rejected if the actual weight varies more than 5 per cent from their theoretical weight, as shown by the manufacturer's tables. For weighing reinforcement bars the contractor shall, whenever required, provide an accurate scale of an approved type, with a capacity of not less than 500 pounds.

Properties considered	Structural steel grade		Hard grade*		
	Plain bars	Deformed bars	Plain bars	Deformed bars	Cold twisted bars
Phosphorus, maximum					
Bessemer	0.10	0.10	0.10	0.10	0.10
Open Hearth	0.05	0.05	0.05	0.05	0.05
Ultimate tensile strength pounds per sq. in.	55,000 to 70,000	55,000 to 70,000	80,000 min.	80,000 min.	Recorded only
Yield point, minimum, pounds per sq. in.	33,000	33,000	50,000	50,000	55,000
Elongation, minimum per cent in 8 inches	$\frac{1,400,000}{\text{tens. str.}}$	$\frac{1,250,000}{\text{tens. str.}}$	$\frac{1,200,000}{\text{tens. str.}}$	$\frac{1,000,000}{\text{tens. str.}}$	5 per cent
Cold bend without fracture:					
Bars under ¾ in. in diameter or thickness	180° d. = 1t.	180° d. = 1t.	180° d. = 3t.	180° d. = 4t.	180° d. = 2t.
Bars ¾ in. in diameter or thickness and over,	180° d. = 1t.	180° d. = 2t.	90° d. = 3t.	90° d. = 4t.	180° d. = 3t.

* The hard grade will be used only when specified.

t = nominal thickness or diameter of bar.

Quality

111. All steel for reinforcement bars shall be made by the open hearth process, and shall conform to the latest revised Standard Specifications for Steel Reinforcement Bars adopted by the American Society for Testing Materials.

The chemical and physical properties of the steel shall be as follows: (See page 332.)

112. Reinforcement bars shall be rolled from billets of new steel; they shall be straight and free from seams, flaws, cracks and imperfections of all kinds.

Tests and inspections

113. The provisions of sections 95, 98, 99, 100 and 102 relating to tests and inspections of structural steel shall also apply to tests and inspections of steel reinforcement bars.

114. Test pieces 18 inches long may be cut from any of the bars delivered on the work, and the failure of any test piece to meet the specified requirements, or the failure of any bar when being tested or handled shall be deemed sufficient cause for the rejection of all steel from the melt from which the test piece or bar was made.

Protection

115. Bars shall be protected at all times from mechanical injury and from the weather, and when placed in the work they shall be free from dirt, scale-rust, paint and oil. Bars which are to be embedded in concrete but which remain exposed for some time after being placed in the work, shall, if directed, be immediately coated with a thin grout of equal parts of cement and sand.

Cutting and bending

116. Bars shall be bent to the shapes shown on the plan and in conformity with approved templets. When bars are cut and bent on the work, the contractor shall employ competent men and shall provide the necessary appliances for the purpose.

Placing

117. All bars shall be as long as can be conveniently used, accurately bent, placed, spaced and jointed as shown or directed,

and they shall be securely held in their positions by approved devices until the concrete has been placed around them.

Joints

118. Where more than one bar is necessary to complete a required length the joints shall be made by means of approved clamps which will develop the full strength of the bars or by looping the ends of the bars around each other in such a manner as to produce and maintain tension on the joint during construction or by lapping the ends of the bars, as directed, and wiring them together in an approved manner, or by lapping the ends of the bars for a distance of 21 times their nominal diameters for deformed bars, and 40 times their nominal diameters for plain bars, and with a space not less than 2 inches between them. Joints in longitudinal bars shall be staggered as directed.

Measurement

119. The weight of steel reinforcement bars paid for as such will be the weight computed from the lengths and theoretical net sections of the steel reinforcement bars placed in the work in accordance with the plan or directions, except such steel reinforcement bars shown on the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures. The weight paid for will not include the lengths of bars used for laps or wires, clamps and other devices used for spacing, jointing and securing the bars in place, or lugs, corrugations and irregularities which increase the weight of the bars above the weight of plain steel bars of the same net cross sectional areas, the cost of all of which shall be covered by the price bid for steel reinforcement bars. In computing the weight of bars, 1 cubic foot of steel will be considered to weigh 489.6 pounds.

Price to include

120. The price bid for steel reinforcement bars shall include the cost of all labor and materials required to furnish, clean, cut, bend, place, join, secure and protect the same, to furnish all test pieces and samples, all as specified.

WIRE NETTING

Type, quality, etc.

121. Wire netting of approved type and quality, and of the mesh and gauge of wire shown on the plan shall be furnished and placed where shown or directed. The netting shall be of steel wire thoroughly galvanized. When wires of No. 12 gauge or larger size are used, they shall be welded before being galvanized. When placed in the work, wire netting shall be free from dirt, paint and oil. It shall be securely held in place by an approved method until the concrete has been placed around it.

Cost to be covered

122. The cost of all labor and materials required to furnish and place wire netting as specified shall be covered by the contract price for the structure or class of work in connection with which it is used.

EXPANDED METAL

Type, quality, etc.

123. Expanded metal of approved type and quality and of the weight and size of mesh shown on the plan shall be furnished and placed where shown or directed. When placed in the work, it shall be free from dirt, scale, rust, paint and oil. It shall be placed in position with adjoining sheets lapped 1 mesh, and secured by an approved method until the concrete has been placed around it.

Measurement

124. The amount of expanded metal paid for as such will be all expanded metal placed in the work in accordance with the plan or directions, except such expanded metal shown on the plan as part or parts of structures for which there are contract prices, and which is hereinafter specified to be covered by contract prices for such structures. The amount paid for will not include waste material cut from sheets, nor the material used for laps, nor wires, clamps and other devices used in joining and

securing the expanded metal in place, the cost of all of which shall be covered by the contract price for expanded metal.

Price to cover

125. The contract price for expanded metal shall cover the cost of all labor and materials required to furnish, clean, cut, bend, place, join and secure the same as specified.

WROUGHT IRON

Quality

126. Wrought iron shall be double rolled, tough, fibrous and uniform in quality. It shall be thoroughly welded in rolling and be free from surface defects. It shall have an ultimate tensile strength of at least 48,000 pounds per square inch, a yield point of 25,000 pounds per square inch, an elongation of at least 20 per cent in 8 inches, and a fracture wholly fibrous. Specimens shall bend cold, with the fiber, through 180 degrees around a diameter equal to the thickness of the piece tested. When nicked and bent the fracture shall be at least 90 per cent fibrous.

Galvanizing, painting

127. When required by the plan exposed wrought iron shall be thoroughly and uniformly galvanized. When not required to be galvanized exposed wrought iron shall be painted as specified in paragraph . . .

Measurement

128. The amount of wrought iron paid for as such will be all wrought iron placed in the work in accordance with the plan or directions, except any excess greater than 2½ per cent above the weight required, and except such wrought iron shown on the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures.

Price to cover

129. The contract price for wrought iron shall cover the cost of all labor and materials required to furnish, fabricate, erect

and galvanize or paint the same, as specified, and to furnish all test pieces required.

IRON CASTINGS

Quality

130. Iron castings shall be of the best foundry pig iron, gray, tough and free from cold shuts, blow holes and other imperfections. The castings shall be sound, true to form and thickness, clean and neatly finished. Where required castings shall be thoroughly coated with coal tar pitch varnish.

Cost covered

131. The cost of all labor and materials required to furnish, place and coat the castings as specified, shall be covered by the contract price for the structure or class of work in connection with which they are used.

TIMBER

Quality

132. All timber shall be long leaf pine or ...., as specified, and shall be sound and free from shakes, cracks, large or loose knots, and other defects impairing its strength or durability. It shall be squared to the required dimensions throughout its entire length.

Placing

133. Timber shall be placed as shown on the plan or directed, and where necessary shall be firmly spiked or bolted with approved nails, spikes or bolts of such sizes and lengths and at such places and in such numbers as shown on the plan, or as directed.

Measurement

134. The amount of timber to be paid for as such will be all timber placed in the work in accordance with the plan or directions, except piles and timber sheeting, and except such timber shown on the plan as part or parts of structures for which there are contract prices, and the cost of which is hereinafter specified to be covered by the contract prices for such structures. The

amount paid for will not include timber used for forms, templets, centers, scaffolds, bridges (unless otherwise specified), fences, guard rails or other temporary structures, the cost of all of which shall be covered by all the contract prices for all the items for which there are contract prices. No deduction will be made in the measurement of timber on account of the spaces occupied by the piles.

Price to cover

135. The contract price for timber shall cover the cost of all labor and materials required to furnish, work, place and secure the same as specified.

TIMBER SHEETING

Quality, placing, etc.

136. Timber sheeting and the rangers and braces for the same shall be of a satisfactory quality of timber and of sufficient size and strength to adequately support the sides of the trenches. Sheeting shall be driven in such a manner as to avoid cracking and splitting, and if required, shall be tongued and grooved.

When paid for

137. Timber sheeting will be paid for only when left in place by written order. When sheeting is left in, so much of it below the surface of the ground as may be directed shall be cut off.

Measurement

138. The amount of timber sheeting to be paid for as such will be all timber sheeting, rangers and braces left in by written order, and will not include sheeting, rangers and braces left in place without such order, nor sheeting left in place because concrete is placed against it, nor that part of the sheeting that extended above the surface of the ground after having been driven, the cost of all of which shall be covered by all the contract prices for all the items for which there are contract prices.

Price to cover

139. The contract price for timber sheeting shall cover the cost of all labor and materials required to furnish, place and cut

off the sheeting, rangers and braces as specified, and shall also cover the cost of all excavation necessary to place the same.

PILES

Quality

140. Piles shall be of yellow pine or ...., as specified, sound and free from splits, shakes and other imperfections impairing their strength or durability. They shall be straight, taper uniformly from butt to point, and if so specified shall be barked. Unless otherwise shown on the plan, they shall conform to the following dimensions:

Length below cut-off	Minimum diameter at point	Minimum diameter at cut-off
	inches	*inches*
Less than 20 feet..............	6	10
20 feet to 25 feet..............	6	11
26 feet to 35 feet..............	6	12
36 feet to 45 feet..............	6	13
46 feet and over...............	6	14

To determine the necesssary length of piles to be used in the work, the Contractor may be required to drive test piles.

141. Each pile less than 60 feet long shall be in one piece; piles longer than 60 feet may be spliced in an approved manner. The small end of the pile shall be pointed, and, if required, shall be shod with an approved iron shoe. The butt end shall be cut off square and protected while driving with an iron band or cap.

How driven

142. Piles shall be driven without the use of a follower, unless specially permitted. Pile heads that become split or broomed shall be cut off and the driving continued. Any pile which splits, breaks or drives unsatisfactorily will not be paid for, and it shall be withdrawn or abandoned and another driven in place of it. After being driven, all piles shall be accurately cut off at the required elevation.

Bearing piles

143. Bearing piles shall be driven vertically and shall be spaced as shown on the plan or as directed. They shall be driven to a satisfactory refusal by a hammer having a concave face and weighing not less than 2000 pounds. Refusal in general will be indicated by a penetration not exceeding 1 inch per blow under the last 6 blows of a 2000 pound hammer falling 15 feet. If steam hammer pile drivers are used, the piles shall be driven so that their bearing power shall be not less than that of piles driven as herein specified. When it is shown on the plan or specified that piles are to be driven to a certain required depth, they shall be driven by the use of a water jet, hammer, or by any other approved method as may be necessary to reach this depth.

Brace piles

144. Where shown on the plan, brace, batter or spur piles shall be driven at the inclination shown or directed, and the tops shall be framed, bolted or strapped to adjoining piles or to each other as shown on the plan.

Measurement

145. The amount of piles to be paid for will be the total length below cut-off of all piles remaining in the work in accordance with the plan or directions, and the total length of all piles used only as test piles. Piles driven for temporary use will not be paid for.

Price to include

146. The contract price for piles shall cover the cost of all labor and materials required to furnish, drive and cut off the same as specified, of fastening brace piles, and of furnishing and placing all shoes, bands, bars, straps, bolts and other fastenings required.

CONCRETE SEWERS

Inverts

147. Inverts of concrete sewers shall be formed between transverse templets and shall be screeded. The templets shall be

placed at such intervals as to divide the invert into sections of suitable size for convenient construction, and unless otherwise permitted, the concrete shall be deposited in alternate sections and allowed to set before the remaining sections are built. Unless otherwise shown on the plan, a layer of mortar not less than ½-inch thick shall be spread evenly and to a smoothly finished surface upon the concrete of the invert as soon as such concrete is in place. Where the radii of inverts are too short to permit screeding between templets, the inverts shall be shaped by means of suitable forms, which shall be removed as soon as the concrete has a sufficient set, and if required, the surfaces of inverts shall be floated or troweled to a smooth finish. The concrete for inverts shall be deposited continuously for their entire cross sections, and for such longitudinal distances as may be convenient. Where shown on the plan, inverts shall be lined with brick masonry which shall be laid at such times and in such manner as may be directed. Inverts shall be carefully protected from all injury during progress of the work.

Side walls

148. Concrete in the side walls of sewers shall be deposited continuously to the height directed and for such longitudinal distances as may be convenient.

Roof

149. Concrete in the roofs of sewers shall be deposited continuously for the full depths and widths of the roofs and for such longitudinal distances as may be convenient. The outer surfaces of roofs shall be finished with an excess of mortar and left true and smooth. They shall be covered and protected as specified in section 73, and such covering shall remain thereon until the backfilling or embankment is placed.

Bulkheads

150. While being deposited the concrete for sewers shall be confined by temporary, vertical bulkheads placed at such intervals longitudinally as may be required for convenient working. They shall be so designed as to give an approved shape to the end of the

section of concrete under construction, shall be satisfactorily secured in place before the concrete is deposited, and shall remain in place until the concrete has set sufficiently to hold its shape.

Reinforcement

151. Where shown on the plan concrete sewers shall be reinforced with metal of the dimensions and shapes shown, and of the quality and in the manner hereinbefore specified.

Minimum-length of invert

152. Unless otherwise permitted or ordered, not less than 16 feet of foundation or invert for concrete sewer shall be built at one operation.

Connections

153. Connections and branches for lateral sewers and receiving basins shall be built in where shown on the plan or where directed. Such connections and branches shall be closed with bulkheads of brick masonry 8 inches thick unless otherwise shown on the plan. All necessary openings and bulkheads for branch sewers shall be built in concrete sewers where shown on the plan or where directed.

Measurements

154. The lengths of concrete sewers will be determined by measurements along their inverts parallel to their centre lines. No deductions will be made on account of openings at branches and manholes. The measurement of a branch concrete sewer will be made from the inner surface of the wall of the main sewer to which it connects. A reducer will be paid for at the contract price for the sewer at the larger end thereof.

Prices to cover

155. The contract prices for concrete sewers shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of furnishing, maintaining and removing all forms, centers, templets and temporary bulkheads; of all openings and bulkheads; also the removal of all bulkheads in the ends of sewers to which connection is made by the sewers

in this contract; of all backfilling; of all embankments required; and of all labor and materials required to construct concrete sewers as shown by the normal sections on the plan and as specified.

BRICK SEWERS

Inverts

156. Inverts of brick sewers shall conform to lines drawn between transverse templets, and shall be lined with specially selected bricks, unless vitrified bricks are called for on the plan; no bats shall be used except for closers.

Arches

157. The arches of brick sewers shall be keyed with stretchers in full joints of mortar and shall be built on substantial centers. No bats shall be used in the neat courses except for closers. The centers shall be true to the required shapes and sizes and shall be strong enough and so secured in place as to withstand all operations incidental to the construction of the arches. The extrados of the arches shall be smoothly and evenly plastered with a layer of mortar ½ inch thick. The centers shall be left in place until the mortar has set sufficiently to permit their removal without danger to the arches, and until the trench is backfilled for its full width to a height of at least 1 foot above the crown of the extrados of the arches. No centers shall be struck or removed until permission to do so has been given.

Minimum length of cradle

158. Unless otherwise permitted or ordered, not less than 16 feet of foundation or cradle for brick sewer shall be built at one operation.

Branches, measurements, etc.

159. The construction of connections and branches for lateral sewers and receiving basins, and of openings and bulkheads, and the measurement of brick sewers shall in all respects conform with the requirements hereinbefore specified for concrete sewers in sections 153 and 154.

Prices to cover

160. The contract prices for brick sewers shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of furnishing, placing, maintaining and removing all templets and centers; of all openings and bulkheads, also the removal of all bulkheads in the ends of sewers to which connection is made by the sewers in this contract; of all backfilling; of all embankments required; and of all labor and materials required to construct brick sewers as shown by the normal sections on the plan and as specified.

VITRIFIED PIPE SEWERS

Vitrified pipe

161. Vitrified pipe sewers shall be built of shale or clay hub and spigot pipes with deep and wide sockets. The pipes shall be manufactured at a suitable temperature, to secure a tough, vitreous material, without warps, cracks or other imperfections, and shall be fully and smoothly salt-glazed over the entire inner and outer surfaces, except that the inside of the hub and the outside of the spigot may be unglazed for two-thirds the depth of the hub. On all other portions of the pipe the glazing shall completely cover and form an integral part of the pipe body. If not left unglazed the inside of the hub and the outside of the spigot shall be scored in 3 parallel lines extending completely around the circumference.

When it is broken, vitrified pipe shall show dense and solid material, without detrimental cracks or laminations; it shall be of such toughness that it can be worked with a chisel and hammer, and when struck with a hammer, it shall have a metallic ring.

Identification marks

162. Each pipe shall have clearly impressed on its outer surface the name of the manufacturer and of the factory in which it was made.

Shape and dimensions

163. The sizes of the pipes are designated by their interior diameters. Each pipe shall be a cylinder with a circular section, and shall have a uniform thickness.

164. The minimum lengths, thicknesses, depths of hubs and annular spaces for the respective sizes of vitrified pipes shall be as follows:

Size	Length	Thickness	Depth of socket	Annular space
inches	*feet*	*inch*	*inches*	*inch*
6	2	⅝	2½	⅝
8	3	¾	2¾	⅝
10	3	⅞	2¾	⅝
12	3	1	3	⅝
15	3	1¼	3	⅝
18	3	1½	3¼	⅝
20	3	1⅔	3½	⅝
22	3	1⅝	3¾	⅝
24	3	2	4	⅝
27	2½	2¼	4	¾
30	2½	2½	4	¾
33	2½	2⅝	5	1¼
36	2½	2¾	5	1¼
42	2½	3½	5	1¼

Curves, bends, etc.

165. Where curved pipes are required they shall be furnished in either one-eighth or one-quarter bends of their respective sizes. Curved pipe, bends, siphons, and special pipe of the sizes and forms shown on the plan shall be furnished and laid, and unless otherwise provided they will be paid for at the contract prices for the corresponding sizes of vitrified pipe sewers.

Samples for testing

166. Any or all of the following tests may be applied to samples selected by the Engineer from the pipe delivered on the work. For the purpose of making such tests as may be required the contractor shall furnish and deliver, where directed, and at the place required, one length of pipe for each 200 feet of pipe sewer to be laid.

Crushing tests

167. When supported at the bottom upon a knife edge one inch in width in such manner that an even bearing is provided throughout the whole length, exclusive of the bell, and pressure

is applied at the crown uniformly through a similar knife edge, the various sizes of pipe shall withstand the following pressures:

Diameter	Pressure	Diameter	Pressure
inches	*lbs. per lin. ft.*	*inches*	*lbs. per lin. ft.*
6	900	22	1750
8	900	24	1950
10	1000	27	2150
12	1050	30	2350
15	1250	33	2500
18	1400	36	2800
20	1550	42	3200

Drop weight test

168. When supported on a dry sand bed 2 inches deep, all pipe shall withstand without cracking the impact from 2 blows of a cast iron ball weighing 8 pounds falling 18 inches. Spurs shall resist without fracture the impact from 2 blows of such a ball falling 6 inches and striking on the extreme end of the hub of the spur.

Hydrostatic test

169. When subjected to an internal hydrostatic pressure of 8 pounds per square inch, vitrified pipe shall show no percolation.

Absorption test

170. After having been thoroughly dried and then immersed in water for 24 hours, sample pieces of vitrified pipe about 10 square inches superficial area with all broken edges shall not absorb more th an 5½ per cent of their weight of water.

Factory rejection

171. The entire product of any pipe factory may be rejected when, in the judgment of the engineer, the methods of manufacture fail to guarantee uniform results, or where the materials used are such as produce inferior pipe, as indicated by repeated failure to comply with the tests herein specified.

Cradles

172. In earth trenches pipe sewers shall be laid in concrete cradles when required by the plan. In rock trenches pipe sewers shall be laid in cradles of concrete, gravel or broken stone or sand as shown on the plan.

Without cradle

173. When the sewer is to be laid without a cradle the trench shall be excavated as specified in paragraph 15, and the earth forming the bed carefully freed of stones. The pipe shall then be evenly bedded therein, the joint properly made and the backfilling placed and firmly tamped in such a manner as to avoid disturbing the sewer.

Concrete cradle

174. When the sewer is to be laid in a concrete cradle, the concrete for the full width of the cradle shall be deposited continuously to the height of the outside bottom of the pipe. Before the concrete has set the pipe shall be evenly bedded therein and the remainder of the concrete immediately deposited and carefully tamped in such a manner as to avoid disturbing the sewer.

Gravel or broken stone cradle

175. When the sewer is to be laid in a gravel or broken stone cradle, the latter shall consist of clean gravel or sound broken stone, all of which will pass through a 1 inch mesh, and be retained on a $\frac{1}{8}$ inch mesh screen. The gravel or broken stone shall be deposited and tamped for the full width of the trench to the height of the outside bottom of the pipe. The pipe shall then be bedded therein and the remainder of the gravel or broken stone deposited and carefully tamped in such a manner as to avoid disturbing the sewer.

How laid

176. All pipes shall be laid with ends abutting and true to line and grade. The pipes shall be fitted together and matched so that when laid in the work they will form a sewer with a smooth and uniform invert. Unless otherwise permitted or directed, not less than . . . feet of pipe sewer shall be laid in one operation.

177. Unless otherwise shown on the plan, the joints of vitrified pipe sewers shall be made as hereinafter specified in section 179.

Plain mortar joints

178. Plain mortar joints shall be made in the following manner. Before a pipe is laid, the lower half of the hub of the preceding pipe shall be plastered on the inside with stiff mortar mixed 1 to 1, and of sufficient thickness to bring the inner bottoms of the abutting pipes flush and even. After the pipe is laid, the remainder of the hub shall be thoroughly filled with similar mortar and the joint wiped inside and finished to a smooth bevel outside.

Gasket and mortar joints

179. Gasket and mortar joints shall be made in the following manner: A closely twisted hemp or oakum gasket of suitable diameter, in no case less than ¾ inch, and in one piece of sufficient length to pass around the pipe and lap at the top, shall be solidly rammed into the annular space between the pipes with a suitable calking tool. Before being placed, the gasket shall be saturated with neat cement grout. The remainder of the space shall then be completely filled with plastic mortar mixed 1 to 1 and the joint wiped inside and finished to a smooth bevel outside.

Inspection of joints

180. Unless otherwise permitted, at least 4 finished joints shall be left exposed for inspection throughout the working day, and the necessary staging for the protection of the exposed sewers and for the handling of excavated material shall be provided. A suitable ladder affording easy access for such inspection shall be furnished at every trench open for the proposed sewer. The joints on the inside of all pipe sewers larger than 15 inches in diameter, shall be carefully filled with mortar and wiped smooth and flush with the surface of the pipe.

Subgrade to be tested

181. No pipe or the cradle therefor shall be laid or placed until the subgrade of the trench shall have been tested and found correct.

Sewer to be kept clean

182. The interior of the sewer shall, as the work progresses, be cleared of all dirt, cement and superfluous materials of every description.

Backfilling

183. Immediately after the sewer is laid the trench shall be backfilled as provided in sections 31, 32, 34, 35, 36, 37, 38 and 39. No walking on or working upon the completed sewer (except as may be necessary in tamping the backfilling) will be permitted until the trench has been backfilled to a height of at least 2 feet over the top of the sewer.

184. The exposed ends of pipe sewers shall be provided with approved temporary covers fitted to the pipe so as to exclude earth or other materials.

Branch pipes

185. Branch pipes and connection pipes shall be of the same quality and dimensions, and laid in the same manner as specified for pipe sewers. Dead ends of pipes shall be closed with bulkheads of brick masonry 8 inches in thickness.

Connection with existing work

186. Wherever the proposed sewer is to connect with an existing manhole in which there is a branch pipe which is damaged or of unsuitable size or in improper position, such pipe shall be removed and be replaced with a pipe of suitable size or be reset in the proper position. The pipe so substituted or reset will be paid for at the contract price.

Pipes cut to fit masonry

187. The ends of pipes which enter masonry shall be neatly cut to fit the face of the masonry. When directed, such cutting shall be done before the pipes are built in.

Measurement

188. The length of pipe sewers to be paid for will be determined by measurements along their invert lines, and no deductions will be made on account of openings at manholes.

Prices to cover

189. The contract prices for pipe sewers shall cover the cost of all necessary excavation (except rock when there is a contract price for rock excavation), of all gravel or broken stone cradles required; of all necessary trimmings, fitting and building into masonry; of all bulkheads, also the removal of all bulkheads in the ends of sewers to which connection is made by the sewers in the contract; of all backfilling; of all embankments required; of all samples furnished; and of all labor and materials required to furnish and lay the sewers complete in place, as shown on the plan and as specified.

CEMENT CONCRETE PIPE SEWERS, WITHOUT REINFORCEMENT

Shape and dimensions

190. Cement concrete pipe sewers, without reinforcement, used in the construction of sewers, shall be hub and spigot pipes with flat bases and conforming in dimensions to the standard plan on file in the office of the engineer. Variations not greater than one-half ($\frac{1}{2}$) per cent from such dimensions will be permitted.

191. They shall be egg-shaped in section for 12-inch and larger sizes, and shall be equal in quality to samples marked standard on exhibition at the engineer's office.

Quality of pipe

192. When concrete pipe is broken it shall appear homogeneous, be entirely free from cracks or voids and generally uniform, showing pieces of fractured stone, firmly imbedded in the mortar.

Proportions

193. The concrete used in the manufacture of cement concrete pipe shall be composed of a mixture of the best quality of Portland cement, clean sharp sand and clean broken stone or gravel suitably graded and equal in quality to similar materials specified herein for concrete, and properly proportioned to produce a pipe that will comply with all the requirements specified in sections 194 to 201 inclusive.

Method of making

194. Methods of molding, trimming and seasoning cement concrete pipe are left to the discretion of the manufacturer; as furnished, it shall be without warps, cracks or imperfections, and shall present smooth inner and outer surfaces with no stones visible.

Delivery

195. No pipe shall be delivered on the work or used within . . . . days after manufacture.

Inspection

196. The materials used in the manufacture, the process of manufacture and the marking and dating of pipe shall be subject to inspection at the factory by inspectors designated by the engineer.

Date of molding

197. All pipe shall have manufacturer's name and the date of molding clearly impressed on the outer surface as identification marks.

Tests

198. Sections 165, 166; 168, 169, 171, 172 173, 174 relating to "curves, bends, etc.," "samples for testing," "drop weight tests," "hydrostatic pressure test," "factory rejection," "cradles", "without cradles," "concrete cradles," and all sections 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188 and 189, relating to manner of laying, jointing, inspection, etc., etc., of vitrified pipe sewers shall govern in the manufacture of cement concrete pipe and the construction of cement concrete pipe sewers, wherever applicable. Crushing tests shall be applied as in Section 167, except that flat base of pipe shall rest on sand bed not less than 2-inches thick, and pressure through a knife edge one inch thick shall be applied at the crown.

Spurs and branches

199. The manner of forming and joining spurs and branches with hubs of standard dimensions to cement concrete pipe shall be such as to insure a tight union, of ample strength to meet the

requirements of the work and of the tests heretofore specified for spurs and branches on vitrified pipe.

Absorption tests

200. After having been thoroughly dried and then immersed in water for 24 hours, sample pieces of cement concrete pipe of about ten square inches superficial area, with broken edges, shall not absorb more than seven and one-half (7½) per cent of their weight of water.

Dimensions

201. The minimum lengths, thicknesses, depths of hubs and annular spaces for the respective sizes of cement concrete pipes shall be as follows:

Diameter	Length	Thickness	Depth of socket	Annular space	
inches	*feet*	*inches*	*inches*		
6	2	¾	2½	Not less than ⅝ inch	And as shown on Standard Plan.
8	3	⅞	2½	Not less than ⅝ inch	
10	3	1	2⅝	Not less than ⅝ inch	
12	3	1¼	2¾	Not less than ⅝ inch	
15	3	1½	2¾	Not less than ⅝ inch	
18	3	1¾	3	Not less than ¾ inch	
20	3	2	3	Not less than ¾ inch	
22	3	2¼	3¼	Not less than ¾ inch	
24	3	2½	3¼	Not less than 1-inch.	

CEMENT CONCRETE PIPE SEWERS WITH REINFORCEMENT

Shape and dimensions

202. Reinforced cement concrete pipes used in the construction of sewers shall be either circular in section without flat base, or egg shaped in section with flat base, and shall conform in dimensions to the standard plan on file in the office of the engineer. Variations not greater than one-half (½) per cent from such dimensions will be permitted.

Ends of pipes

203. The ends of such pipes shall be molded with hubs and spigots or with any other shapes which are satisfactory to the engineer, and which will permit the making of tight, smooth and

permanent joints. The shapes of the pipe ends shall be such as to require and permit the making and finishing of the joints both on the inside and outside of the sewer.

204. The pipes shall conform to the requirements in section 192, and shall be equal in quality to samples marked "Standard" on exhibition at the engineer's office.

Dimensions, etc.

205. The minimum lengths, thicknesses and depths of hubs for the respective sizes of reinforced cement concrete pipes shall be as follows:

Size	Lengths	Thickness	Depth of socket
inches	*feet*	*inches*	*inches*
24	4	3	3½
30	4	3½	4
36	4	4	4¾
42	4	4½	5½
48	4	5	6
54	4	5½	6½
60	4	6	6½
66	4	6½	6½
72	4	7	6½
78	4	8	6½
84	4	8	6½

Type of reinforcement

206. The steel used for reinforcement of cement concrete pipe shall conform to the requirements for such material specified in section No. 111.

a. It shall be either expanded metal rods or wire mesh, equal in quality and design to that manufactured by the American Steel and Wire Company.

b. Where reinforcement in pipes is exposed, it shall be thoroughly painted with cement grout so as to prevent deterioration by exposure to the weather, unless the reinforcement be galvanized.

Reinforcement for circular pipes

207. In all sizes of circular reinforced cement concrete pipes from 24 inches to 48 inches diameter inclusive, reinforcement

shall be placed at distances varying from 1 inch to 1½ inches from the inner surfaces, according to diameter of pipes.

a. Either one or two lines of reinforcement may be used in the above sizes of pipes.

b. In all circular pipes whose diameters exceed 48 inches two lines of reinforcement shall be used.

c. The inner line of reinforcement shall be placed within two (2) inches of the inner surface. The outer line of reinforcement shall be placed within 1½ inches of the outer surfaces.

Reinforcement for egg shape pipe

208. In all sizes of egg shaped reinforced cement concrete pipes, reinforcement shall be placed in such manner as to best resist stresses induced by external loads, and in a manner satisfactory to the engineer. In all cases the shapes to which reinforcement shall be bent in the finished pipe shall be smooth and true, so that its position in the pipe shall conform at all points to that shown on the standard plan.

Samples for testing

209. Any or all of the folllowing tests may be applied to samples selected by the engineer from the pipe delivered on the work. For the purpose of making such tests as may be required, the contractor shall furnish and deliver, when directed, and at the place required, three lengths of each size of pipes used in the work.

Crushing tests

210. When tested in the manner described in Section No. 167, the various sizes of pipes between 24-inch and 42-inch in diameter inclusive, shall withstand the following pressure.

When supported upon a saddle which extends the full length of the pipe exclusive of the bell and whose upper surface fits accurately the outer curved surface of the pipe, and whose width is equal to an arc of 15 degrees, in such a manner that an even bearing is provided throughout the whole length, and pressure is applied at the crown uniformly through a knife edge one-inch in width, the various sizes of pipes with diameters greater than 42-inches shall withstand the following pressure:

Diameter	Pressure	Diameter	Pressure
inches	*lbs. per lin. foot*	*inches*	*lbs. per lin. foot*
24	2150	60	5500
30	2700	66	6000
36	3300	72	6500
42	3800	78	7000
48	4400	84	7500
54	5000		

Hydrostatic and absorption tests

211. When subjected to an internal hydrostatic pressure of twelve (12) pounds per square inch, reinforced concrete pipe shall show no percolation.

Reinforced concrete pipe shall meet the requirements of the absorption test specified in Section 200.

212. Reinforced cement concrete pipes having openings to receive spur and branch connections shall be furnished and laid at such points as the engineer may designate, opposite all lot fronts, and so that the radiating spurs shall *in general* be spaced an average distance of . . . feet apart on each side of the street, and also at such street intersections where branch connections are called for by the plan. The openings in pipes shall be made in accordance with a plan approved by the chief engineer, and the openings shall be such that connection may be made with the sewer in as effective a manner as is possible with pipes with molded spur connections.

General

213. All the sections relating to vitrified pipe sewers and to cement concrete pipe sewers without reinforcement which are pertinent and applicable to reinforced cement concrete pipe sewers unless otherwise specified herein shall govern in all respects and details.

CAST IRON PIPE SEWERS

Cast iron pipe

214. Cast iron pipe for sewers shall conform with the requirements of the latest revised Standard Specifications for Cast Iron

Pipe adopted by the American Society for Testing Materials, and all tests required shall be made in accordance therewith.

215. The thickness of shell and weight of the several classes of pipe, and the allowable variations of diameter and weight shall be as follows:

Nominal Inside Diam.	Class A, 100 foot Head 43 pounds Pressure		Class B, 200 foot Head 80 pounds Pressure		Class C, 300 foot Head 130 pounds Pressure		Allowable Variations	
	Thickness	Weight	Thickness	Weight	Thickness	Weight	Diameter	Weight
inches	*inches*	*pounds*	*inches*	*pounds*	*inches*	*pounds*	*inches*	
4	0.42	240	0.45	260	0.48	280		
6	0.44	370	0.48	400	0.51	430		
8	0.46	515	0.51	570	0.56	625		
10	0.50	685	0.57	765	0.62	850	0.06	
12	0.54	870	0.62	985	0.68	1,100		5 p.c.
14	0.57	1,075	0.66	1,230	0.74	1,400		
16	0.60	1,300	0.70	1,500	0.80	1,725		
18	0.64	1,550	0.75	1,800	0.87	2,100		
20	0.67	1,800	0.80	2,100	0.92	2,500	0.08	
24	0.76	2,450	0.89	2,800	1.04	3,350		
30	0.88	3,500	1.03	4,000	1.20	4,800		
36	0.99	4,700	1.15	5,450	1.36	6,550	0.10	4 p.c.
42	1.10	6,150	1.28	7,100	1.54	8,600		
48	1.26	8,000	1.42	9,000	1.71	10.900	0.12	
54	1.35	9,600	1.55	11,200	1.90	13,700	0.15	
60	1.39	11,000	1.67	13,250	2.00	16,100		

The above weights are for 12 feet laying lengths and standard sockets; proportionate allowance will be made for any variation therefrom.

Variation in thickness

216. For pipes whose standard thickness is less than 1-inch, the thickness of metal in the body of the pipe shall not be more than 0.08 inch less than the standard thickness; and for pipes whose standard thickness is 1 inch or more, the variation shall not exceed 0.10 inch, except that for areas not exceeding 8 inches in any direction, variations from the standard thickness of 0.02 inch in excess of the allowance above given will be permitted.

Coating

217. All cast iron pipe shall be thoroughly and evenly coated inside and outside with coal tar pitch varnish. The coating shall be smooth, tough and tenacious when cold and shall not be brittle or have any tendency to scale off.

Marking

218. The weight and class letter shall be conspicuously painted by the manufacturer with white oil paint on the inside of each pipe after the coating is hard.

219. Joints of cast iron pipe sewers shall be of the kinds shown on the plan.

Lead joints

220. When lead joints are required, the inner portion of the annular space between the pipes shall be packed with clean, sound jute packing yarn, and the remaining portion shall be run full of pure soft lead and calked with suitable tools. Unless otherwise shown on the plan, the depths of the lead joints shall be 2½ inches for 6-inch to 8-inch pipe; 3 inches for 12-inch to 24-inch pipe, and 3½ inches for 30-inch to 48-inch pipe.

Mortar joints

221. When gasket and mortar joints or plain mortar joints are required they shall be made as specified in Sections 178 and 179.

222. All the requirements, as hereinbefore specified, relating to excavation, laying, backfilling and measurement of vitrified pipe sewers shall apply, as far as they are applicable, to cast iron pipe sewers.

Prices to cover

223. The contract prices for cast iron pipe sewers shall cover the cost of all necessery excavation (except rock when there is a contract price for rock excavation); of all gravel or broken stone cradles required; of all bulkheads; of all backfilling; of all embankments required and of all labor and materials required to furnish and lay the sewers complete in place, as shown on the plan and as specified.

BASIN CONNECTIONS

224. The connections between receiving basins or inlet basins and sewers or manholes shall be of 12-inch vitrified pipe, unless otherwise shown on the plan. The pipes shall be of the same quality and dimensions, and laid in the same manner as hereinbefore specified for vitrified pipe sewers.

Measurement

225. The lengths of basin connections to be paid for will be determined by measurements along their inverts.

Price to include

226. The contract price for basin connections shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of all gravel or broken stone cradles required; of all necessary trimming, fitting and building into masonry; of all backfilling; of all embankments required; and of all labor and materials required to furnish and lay the basin connections complete in place, as specified.

PIPE DRAINS

227. Pipe drains shall be built of vitrified or cement concrete pipe of the same quality and dimensions and laid in the same manner as hereinbefore specified for pipe sewers.

Old drains restored or extended

228. Any existing drain disturbed or removed on account of the work under this contract shall, if required, be restored or connected with the new work as directed. The portions of such drains restored or the extensions thereof will be paid for at the contract prices for pipe drains of the same size.

Measurement

229. The lengths of pipe drains to be paid for will be determined by measurements along their inverts.

Prices to cover

230. The contract prices for pipe drains shall cover the cost of all necessary excavations (except rock, when there is a contract price for rock excavation); of all necessary trimming, fitting and building into masonry; of all backfilling; of all embankments required; and of all labor and materials required to furnish and lay the drains complete in place, as specified.

SPURS FOR HOUSE CONNECTIONS

231. Spurs for house connections shall be of vitrified or cement concrete pipe 6 inches in diameter, equal in quality and dimensions to that specified for pipe sewers.

In brick and concrete sewers

232. In brick and concrete sewers spurs shall be built in as shown on the plan or as directed. They shall be hub and spigot pipes with the spigot end moulded or cut to fit flush with the inner surface of the sewer, and of sufficient length to reach the exterior of the sewer.

In pipe sewers

233. Pipes having 6–inch spurs with hubs moulded thereon shall be furnished and laid in pipe sewers where shown on the plan or directed. The cost of such pipes shall be included in the contract prices for pipe sewers.

Covers

234. The ends of all spurs not connected with drains shall be closed with approved covers of the same material as the pipe. If required, such covers shall be cemented in place, and when directed the covers shall be so cemented before the pipes are lowered into the trench.

Cost to include

235. The cost of spurs and all labor and materials required to furnish and place the same as specified, and furnishing and cementing the covers for the same, shall be included in the contract price of the sewers to which they connect. They shall be furnished and laid as above specified without extra cost to the city.

DRAINS FOR HOUSE CONNECTIONS

236. Where shown on the plan or where directed, drains for house connections shall be built from the spurs in such a manner and for such distance as may be shown or directed.

Depth at curb

237. House connection drains shall be laid with such a gradient as to secure a depth at the curb line of 9½ feet or at a gradient of ¼ inch per foot when possible. Where this is not possible, the depth of the curb line shall be as shown on the plan.

Material

238. Unless otherwise shown on the plan, drains for house connections shall be of pipe of the quality and dimensions specified for pipe sewers. The ends of the drains shall be closed with approved covers of the same material as the pipe.

How laid

239. All the requirements, as hereinbefore specified, relating to excavation, laying and backfilling of pipe sewers shall apply, as far as they are applicable, to drains for house connections.

Measurement

240. The lengths of pipe drains for house connections to be paid for will be determined by measurement along their inverts.

Price to cover

241. The contract price for drains for house connections shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); the cost of all backfilling; the cost of all covers, bends and specials required; and the cost of all labor and materials required to furnish and lay the drains for house connections complete in place, as specified and as shown on the plan.

RISERS

242. Where shown on the plan or where directed, risers for house connections shall be built from the spurs in such a manner

and to such height as may be shown on the plan or directed. Unless otherwise shown on the plan, they shall be of pipe of the quality and dimensions herein before specified for pipe sewers. They shall be supported and surrounded by concrete as shown, and each shall be closed with an approved cover of the same material as the pipe.

Measurement

243. The lengths of risers to be paid for will be determined by measurements along their axes.

Price to include

244. The contract price for risers shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); the cost of all concrete used in connection with the risers; the cost of all backfilling; the cost of all covers, bends and specials required; and the cost of all labor and materials required to construct the risers complete in place, as specified.

MANHOLES

245. The masonry or concrete for manholes shall be built to within . . . inches of the established grade of the street or to within . . . inches of the existing surface of the ground, as directed. When not built up to within . . . . inches of the established grade of the street, the masonry or concrete shall, if directed, be covered with bluestones not less than 5 inches thick or with an approved reinforced concrete slab to support the head.

Brick manholes

246. Brick manholes shall be formed by means of templets placed at top and bottom with not less than 8 lines drawn between them if directed by the engineer, and they shall be smoothly and evenly plastered on the outside with a layer of mortar ½ inch thick.

Concrete manholes

247. Concrete manholes shall be built of the materials, sizes and dimensions shown on the plan.

Steps

248. Galvanized wrought iron steps of the size and shape shown on the plan shall be firmly built into the manholes at vertical intervals of about 16 inches.

Head and cover

249. Manhole heads and covers shall be of cast iron, and unless otherwise shown on the plan, each head, exclusive of cover, shall weigh not less than 475 pounds and each cover shall weigh not less than 135 pounds. The weight of each head and cover shall be conspicuously painted thereon by the manufacturer with white oil paint. The head shall be set on the masonry or concrete in a full bed of stiff mortar.

Dust pans, etc.

250. Where shown on the plan, dust pans and protective gratings of the materials, forms and dimensions shown shall be furnished and fitted in the manholes.

Price to cover

251. The contract price for manholes shall cover the cost of all necessary excavation, (except rock, when there is a contract price for rock excavation), of all backfilling; of all plastering; of all bluestones, of all concrete slabs; of all steps; of dust pans and protective gratings, when required; and of all labor and materials required to construct the same complete, in place, as shown on the plan and specified.

RECEIVING BASINS

Brick basins

252. Brick receiving basins shall be built in the manner and of the dimensions shown on the plan. They shall be formed by means of templets placed at top and bottom with not less than 10 vertical lines drawn between them, if directed by the engineer. If required, the mouths of receiving basins shall be closed with bulkheads of brick masonry and such bulkheads shall be removed when directed.

Concrete basins

253. Concrete receiving basins shall be built in the manner and of the dimensions shown on the plan. Class A concrete shall be used throughout and shall be placed for both bottom and side walls at one operation.

Concrete heads

254. Where concrete heads or cover slabs of receiving basins or their inlets are built in or adjoin concrete sidewalks, the new work shall be made to correspond in pattern and color with the existing sidewalk.

Pavement at inlets to receiving basins

255. The pavements adjoining the inlets to receiving basins shall be restored and adjusted to the extent and in the manner directed, and in accordance with paragraphs ... and .... In unpaved streets and in macadamized streets, where the inlets to the receiving basins are approximately at the surface of the street, a space of 2½ feet adjoining such inlets shall, if required, be paved with approved paving blocks.

Price to cover

256. The contract price for receiving basins shall cover the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of all cast iron traps and fittings; of the outlet culvert connecting with the sewer; of all backfilling, of all pavement required at the inlets to the basins; of the temporary brick bulkheads in the mouths of the basins or outlet culverts when required; and of all labor and materials required to construct the receiving basins complete in place, as shown on the plan and specified.

STORM WATER INLETS

257. Storm water inlets and the heads and covers therefor shall be of the materials, forms and dimensions shown on the plan. If required, the mouths of inlets shall be closed with bulkheads of brick masonry and such bulkheads shall be removed when directed.

Price to include

258. The contract price for inlets shall include the cost of all necessary excavation, (except rock, when there is a contract price for rock excavation); of all backfilling; of connections with sewers; of the temporary brick bulkheads in the mouths of the inlets when required; and of all labor and materials required to construct the inlets complete, in place, as shown on the plan and specified.

FLUSH TANKS

259. Flush tanks shall be of the materials, form and dimensions shown on the plan. Unless otherwise directed, they shall be connected with the water main and with the sewer. The connection with the water main shall be made under a permit from the proper authorities, and under their rules and inspection.

Price to include

260. The contract price for flush tanks shall include the cost of all necessary excavation (except rock, when there is a contract price for rock excavation); of all backfilling; and of all labor and materials required to construct the flush tanks complete, in place, as shown on the plan, and to connect the same with the water main and the sewer.

EMBANKMENT

Quality

261. Where indicated on the plan, embankment shall be made of the form and dimensions shown. It shall consist of clean steam ashes or filling of the quality specified in Sections 31, 32 and 34, which shall contain no stone over 6-inches in its largest dimension. When the material forming the embankment contains stones, the latter shall be so distributed through the mass that all interstices are filled with fine material, and the material within 2 feet of the sewer shall be free of stones. When embankment is used as foundation it shall consist entirely of filling of the quality specified in Sections 31 and 32.

How made

262. The embankment shall be deposited and spread in horizontal layers to such an extent and at such times as may be

directed. When embankment is used as a foundation, the ground on which it is to be made shall be prepared by grubbing and clearing, and removing all improper material. Embankment used as foundation shall be deposited in uniform horizontal layers not exceeding 1 foot in depth, and each layer shall be thoroughly compacted by rolling or tamping, or both; such embankment shall not be built upon until the expiration of . . . days after its completion.

Approaches

263. Where the embankment obstructs or interferes in any way with any public or private roadway, the contractor shall furnish and place all material necessary to provide suitable approaches of such widths and to such extent as shown on the plan, or as directed.

264. All embankments and approaches shall be maintained at their full dimensions until the completion of this contract.

Cost included

265. The cost of all labor and materials required to prepare the ground, to make the embankment and approaches as specified, to make all necessary excavations and backfilling therein, and to maintain the embankments and approaches at their designated dimensions until the completion of this contract, shall be covered by the contract prices for the structures over or in connection with which they are made.

SLOPE PAVEMENT

How laid

266. Slope pavement shall be not less than 18-inches in depth and shall be composed of sound quarried or split stones. Except when used for pinning or wedging, the stones shall be not less than 6 inches thick and from 12 to 18 inches long. They shall be placed by hand so as to present a fairly even surface, and have their longest dimensions approximately perpendicular to the side of the embankment. At least one-third of the stones shall extend through the pavement. Slope pavement will be measured by its superficial area.

Price to cover

267. The contract price for slope pavement shall cover the cost of all labor and materials required to lay the same complete in place, as specified.

RESTORATION OF SURFACE AND CLEANING UP

Restoration of unpaved roadways, sidewalks, etc.

268. At such time as may be directed, all unpaved roadways, gutters, and sidewalks affected by the work done under this contract shall be restored to the same condition in which they were at the time of the opening of bids for this contract.

Pavements, etc., restored by city

269. Unless otherwise required by the plan, all roadway and sidewalk pavements, cross-walks, curbs, etc., along the line of the work, (except those under guarantee for maintenance by the paving contractor), which are removed, destroyed, lost or injured on account of, or during the construction of the work under this contract, or which are injured by traffic on account of any act or omission on the part of the contractor, his agents, servants or employes, in the prosecution of the work, will be restored and adjusted by the city at the expense of the contractor. For this purpose, before the completion of the contract, and when directed, the contractor shall pay to the city a sum of money sufficient to cover the cost of restoring and adjusting the pavements, cross-walks, curbs, etc., the amount of the work to be done being determined by the engineer, and the cost being computed at the following prices.

	Per sq. yd.
Granite block with concrete foundation, tar and gravel (or cement grout) joints..............................	$..........
Granite block pavement, with sand foundation..........	....
Medina block pavement, with concrete foundation (grouted joints)......................................	....
Brick pavement, with concrete foundation..............	....
Brick pavement, with sand foundation..................	....
Belgian block pavement................................	....
Cobble stone pavement.................................	....

	Per sq. yd.
Macadam pavement	$..........
Iron slag pavement	....
Wood block pavement	....
Asphalt block pavement over 10 yards	....
Asphalt block pavement under 10 yards	....
Sheet asphalt pavement, with concrete foundation, over 10 yards	....
Sheet asphalt pavement, with concrete foundation, under 10 yards	....
Asphalt pavement, without concrete foundation, over 10 yards	....
Asphalt pavement, with concrete foundation, under 10 yards	....
	Per sq. ft.
Cement sidewalk relaid	$..........
New flagging	....
Flagging relaid	....
	Per lin. ft.
Curbstone reset, sand foundation	....
Curbstone reset, concrete foundation,	....
New curbstone furnished and set, sand foundation	....
New curbstone furnished and set, concrete foundation	....
	Per sq. ft.
Bridgestone reset, sand foundation	....
Bridgestone reset, concrete foundation	....
New bridgestone furnished and set, sand foundation	....
New bridgestone furnished and set, concrete foundation	....

Pavements, etc., restored by contractor

270. If required by the plan, roadway and sidewalk pavements, cross-walks, curbs, etc., shall be satisfactorily restored and adjusted by the contractor at such times as may be directed. Sidewalk pavements shall be restored in whole flags, squares or sections which shall correspond in quality and appearance with the original or adjoining flags, squares or sections. All work and materials used in such restoration and adjustment shall conform in all respects to the standard specifications now in use by the city for similar work and materials.

Pavements, etc., under guarantee

271. All pavements, sidewalks, cross-walks, curbs, etc., existing at the time of the opening of the bids for this contract, and under guarantee for maintenance, shall be restored and adjusted

by the parties responsible under such guarantee, and at the expense of the contractor. If not so restored and adjusted during the progess of the work, the contractor shall, when directed, pay to the city, before the completion of the contract, a sum of money sufficient to cover the cost of having the same restored and adjusted by the parties responsible under such guarantee, and at the charges for the restoration of the same, as set forth in their contracts relating thereto. Such sum shall be accompanied by certificates from the parties responsible for the maintenance of the pavements, sidewalks, cross-walks, curbs, etc., to the effect that such sum will be accepted by them as covering the entire quantity of pavement, etc., to be restored and adjusted.

Temporary restoration

272. At such times as may be directed roadway and sidewalk pavements, cross-walks, curbs, etc., which have been removed, whether under guarantee or not, shall be temporarily restored by the contractor to the satisfaction of the engineer.

Change of pavement, etc.

273. When the kinds of pavements, sidewalks, cross-walks, curbs, etc., in any street affected by this contract, are changed after the bids are opened and before work is commenced, the contractor will not be required to make permanent restoration of the new pavement, sidewalks, cross-walks, curbs, etc., disturbed, but a sum of money sufficient to pay the cost of replacing the kinds of pavement, sidewalks, cross-walks, curbs, etc., which were there at the time of the opening of the bids for this contract, will be deducted from the amount which would have been payable to the contractor upon the completion of the contract, had the character of the pavements, etc., not been changed, and such cost will be computed at the prices stated in section 269.

When new pavement is laid

274. If pavement, sidewalks, cross-walks, curbs, etc., are laid where none existed at the time the bids for this contract were opened, the contractor shall excavate and remove such portions of the pavements, sidewalks, cross-walks, curbs, etc., and their

foundations as may be necessary for the prosecution of the work, but he will not be required to make a permanent restoration of them.

Trenches flooded

275. Before laying any pavements, sidewalks, cross-walks, curbs, etc., the trenches shall, if required, be flooded with water, as directed, and all resulting holes or depressions shall be filled and tamped solid.

Unnecessary cross gutters

276. All cross gutters rendered unnecessary by the work under this contract shall be removed and the entire street intersection or so much thereof as may be necessary shall be regraded and repaved as herein specified.

Cleaning-up

277. At such times as may be directed, the contractor shall remove from the streets all materials which were placed thereon by him as a consequence of performing this work, and which are not required by the contract to be left as part of the finished work. The entire work and portions of the street affected thereby shall be left in a satisfactory condition. The sidewalks and cross-walks shall be swept clean of all material which may have come thereon by reason of the work under this contract, and if required, they shall be sprinkled with water during the sweeping.

Cost to be covered

278. The cost of all the labor required to be done and all the materials required to be furnished in the performance of all the work specified in Sections . . . inclusive, shall be covered by all the contract prices for all the items for which there are contract prices.

DISCUSSION

Article 5

Mr. Parkes: I move that the paragraph with reference to taking out stumps be stricken out.

Mr. Craig: We must remember that these specifications are general specifications.

Article 15

Mr. Parkes: With reference to that 8 inches on a side, that means 16 inches larger than the pipe. My specifications read 1 foot larger than the diameter of the pipe. Why make that 4 inches larger?

Mr. Meriwether: I have discussed that clause with Mr. Fort. His reason is to assure plenty of room to tamp the back fill in under the haunches of the pipe.

The President: We use 12 inches over the diameter.

Mr. Rankin: I would suggest that the term "outside diameter" be used instead of "barrel."

Mr. Parkes: I move that the minimum width be made 6 inches instead of 8 inches.

Mr. Myers: I will second that.

Mr. Fisher: We use 18 inches wider than the inside diameter of the pipe. We cannot cover Pine Bluff and New York with details in these specifications. These are made up by men of more experience than any of us, and are general specifications. They will not fit my conditions all the way through or Mr. Parkes' conditions exactly, but with such modifications as the different engineers will have to make, I think it is the best specification we can have. That was the opinion of the committee; we went through it very thoroughly. While there are some things I would want changed somewhat, because they do not agree with my practice, as a general specification I do not believe they could be bettered.

The President: We are, however, establishing a minimum permissible under any circumstance, and I think we should make that to fit the least occasion we have, so if we want to use 8 inches or 9 inches, that would cover the case.

Mr. Reimer: We perhaps need that extra width for the operation of the men wiping the joints. You cannot get a man to thoroughly wipe a joint in a narrow space of 6 inches.

Mr. Parkes: We do succeed in wiping the joints in 6 inches. You have given us a minimum here, and I want the minimum small enough so that we may use the specifications of the society. We do not want to have to violate our specifiations.

(*Mr. Parkes' motion carried.*)

The Secretary: In many of these specifications adopted by this society and by the Society for Standardizing Paving Specifications, I notice a tendency to introduce into the standard specifications little suggestions as to the carrying on of the work. If these are to be adopted as a standard form of specifications, they should not include those little side notes. These are forms that any engineer may fill out according to his requirements and give them to a contractor as his instructions. If they contain alternatives, the engineer must change them, or give the contractor the alternative. You have put a minimum of 6 inches here. The engineer now says that to the contractor. It would seem better, when different towns require different widths, to leave it blank, and let each engineer put in what he pleases. It might be well for the society to place a foot note or suggestion to the engineer at this point, that the society recommends that 6 inches be adopted, or something of that kind.

Mr. Nicholson: I agree with the statement of the secretary I will move that 8 inches be changed to blank inches, and a foot note inserted in the specifications calling attention to the fact that the engineer shall use his own judgment.

Mr. Reimer: I will second that.

Mr. Parkes: This is one of the vital points in the specifications. The most unsatisfactory specifications I ever saw put out is the bituminous pavement specifications put out by the S.P.S, because about every other paragraph says if local conditions justify do so and so, and it does not tell you what you should have to meet these traffic conditions. If you leave it to the judgment of the local engineer, there is no necessity of adopting these specifications. We are all competent to write specifications to construct a sewer or pavement under, but we are trying to lay down the basis of practice, trying to tell him what is the least foundation he should put under his pavement, and the least width at the side of his sewer. If you do not do that, you are not doing what this society is supposed to do. We should take a stand on these things. Let us say, here is a criterion for you to go by. You can depart from this if you want to, but you do it at your own risk. This is the minimum.

The Secretary: That was intended to be provided for by clauses in italics, or footnotes, to put the 6 inches in, but not to put it in the specifications as part of them, because the young engineer will say, here is something handed to me as a model form of specification. All I must do is fill in a few dimensions and hand it to the contractor. He must use some judgment, he cannot take a specification made for the whole country, fill in a few quantities and hand it to the contractor. We can help in footnotes, but do not let us have it turned over to the contractor with a lot of alternatives.

Mr. Hawley: We certainly do not want any engineer to specify less than 6 inches. With those minima, and with a footnote stating these are minima, let him modify it to suit conditions.

The Secretary: The only question seems to be whether to put in 6 inches, and let him cross it out and put in 8 inches, or whether to leave it entirely blank.

Mr. Hallock: I think it a mistake to have too many comments in italics. It is better to put in the minimum and allow the engineer to use his own judgment.

(*Mr. Nicholson withdraws motion.*)

Article 18

Mr. Hughes: I would suggest that you excavate to a certain depth below the flow line, in rock cuts, and that that be paid for.

Mr. Rankin: We allow 4 inches below the external bottom of the pipe. In rock it is not necessary to put a cradle in, but we excavate 4 inches deeper, and then fill with earth and sand, and it is no more than proper that the contractor should be paid for that additional 4 inches.

Article 21

Another thing that is of interest is the paying for boulders, or small pieces of rock. It says there, 1 cubic yard. We find frequently we have a sort of continuous bed of boulders harder to excavate than solid ledge, and on that basis a man might not be paid for them, if they were less than 1 cubic yard. Our practice is to pay for a half yard.

Mr. Hawley: I believe it should be made one-third of a cubic yard, because you can excavate solid rock cheaper than you can boulders one-third of a cubic yard. I believe there should be an allowance of a batter of one in eight in addition to the other width. I move to amend by making that one-third of a cubic yard instead of one, and that a batter slope of one in eight be put in.

Mr. Roess: I will second that.

Mr. Craig: These specifications were prepared by three recognized engineers of the country. Neither of them is here. It occurred to me that any suggestions or modifications that we wish to make, we should make in a separate paragraph, and add them to these specifications. I believe it would be better to do this than to make changes here and there.

(*Vote taken on motion to change from 1 cubic yard to ⅓ of a cubic yard. Motion carried.*)

(*Vote taken on motion to allow 1 foot in 8 batter on each side of the trench. Motion lost.*)

Mr. Craig: I move that these specifications be printed in full in our proceedings, but not adopted, and that the criticisms and suggestions made by the different members be printed, and that the specifications be laid over and referred back to the committee until our next meeting for final adoption.

Mr. Fisher: I second that.

Mr. Wadsworth: The mistake has been made in the past by associations attempting to fix upon specifications for less experienced engineers. They have tacked on too many conditions. I believe this should be taken up and acted upon as we go along.

Mr. Fisher: We ought not to adopt this specification this year, perhaps. There are probably in the United States several thousand engineers who will get these specifications, and the men who are here cannot claim to speak for those who are not. I think the specification should be printed in full, just as it is, not adopted. As to the rock, we use one-half a cubic yard, and would not use a yard of it were in here. But I think the specification should be printed just as it is, and then take such action as we are taking now, take up each paragraph and pass resolutions to change instead of trying to settle it in the time we have and with the experience, necessarily limited, of those who are here. Let it go over until next year. This is the first time this has come up, and we are not in position to adopt this specification and change it at this meeting.

Mr. Roess: If this resolution carries, the whole thing will be referred back to the committee?

The President: Yes sir; we make these suggested amendments and the whole thing is published; and it goes not only before our own membership, but broadcast throughout the land. Then at the next meeting we will go into the matter more fully and possibly be prepared to adopt standard sewer specifications.

Mr. Meriwether: I am a member of the committee of the American Society for Testing Materials on the same subject, of which Mr. Hering is Chairman, and Mr. Provost and Mr. Fort are members, and they have conferred with me on these specifications, to see that the two specifications do not conflict. I know Mr. Provost and Mr. Hering and Mr. Fort have given up their Saturday afternoons for a year in getting these specifications up, and they have threshed them over carefully, and I do not think we can come here and in a few minutes hope to make better ones. I think they should be printed and not adopted.

Mr. Blair: Instead of printing this report and the suggestions and criticisms offered at this meeting in the minutes, and waiting until that publication is issued and in our hands, it seems to me this subject is so important, as are other specifications to come up for consideration, and especially in view of the fact that this effort is an inceptive effort of the society, that these specifications should be printed word for word as offered by this committee in pamphlet form, distributed to our membership in time so that we may have an opportunity not to spend five or ten minutes in criticizing the work passed on by these eminent gentlemen, covering a period of a whole year, but would give us an opportunity to look carefully into this and submit such amendments and suggestions as might occur, prior to the meeting next year. If printed in the proceedings this year, we will advance no more next year. There should be some method by which these criticisms will be passed to the secretary prior to our annual meeting.

Mr. Craig: I agree with Mr. Blair. That has been the plan. I know the committee on paving is always glad to receive criticisms, and this committee, I think, would be the same. These gentlemen have put in much time and are consulting engineers of much experience, and there is not a city represented here that would hesitate, if they had a serious sewage problem to work out, to call upon these men.

(*Motion carried.*)

Mr. Hughes: I move that for pipe under 12 inches diameter the rock shall be excavated 6 inches below the flow line, and between 12 and 30 inches, it shall be excavated 8 inches below the flow line, and filled with earth.

Mr. Rankin: I do not see why you should make a distinction in size. I move the rock be excavated 8 inches below the flow line, regardless of the size.

Mr. Hughes: I will accept that and second Mr. Rankin's motion.

(*Mr. Rankin's motion carried.*)

Articles 41 to 51

Mr. Fisher: Instead of having different specifications for the same things in these several specifications, if we could refer to the standards of the American Society of Civil Engineers or our own standards for materials, it would be better than to lumber the specifications up with so much repetition.

Mr. Meriwether: I think it is the intention of the committee to try to keep this as near as possible to the standards of the American Society for Testing Materials.

Mr. Thompson: With reference to the cement, I think a bag 94 pounds in weight should be considered a cubic foot.

Mr. Meriwether: There is only 0.9 of a cubic foot in the bag.

Mr. Parmley: That depends on how much it is packed. It is purely a matter of convenience, and there are some strong arguments made for making it a unit of 1 cubic foot.

Mr. Roess: Your material and sand you always get loose, and if you use loose cement it evens things up.

Mr. Briggs: I think the Society for Testing Materials considered that subject.

Mr. Meriwether: They have a committee on concrete, and I am quite sure that their specifications consider a bag of cement as 0.9 of a cubic foot.

Mr. Rankin: I move to strike out the clause as to capacity of a bag of cement.

Mr. Thompson: I will second that.

Mr. Meriwether: That is a good plan, because there are some Canadian members here, and the Canadian barrels contain 350 instead of 380 pounds.

(*Motion carried.*)

Mr. Parkes: I move to strike out that entire clause.

Mr. Myers: I will second it.

Mr. Howell: I move to amend the motion by stating that a bag of cement shall be considered as 1 cubic foot.

Mr. Thompson: I will second that.

Mr. Parkes: I will withdraw my motion.
(*Motion of Mr. Howell carried.*)

Article 121

Mr. Meriwether: As to the wire mesh to be used in concrete, I believe it should be left to the discretion of the engineer whether or not it should be galvanized.

Mr. Roess: I have seen iron mesh in use thirty years that was not galvanized.

Mr. Parkes: What would be the object of galvanizing it if it was enclosed in concrete? Why not paint it with asphaltum? Or why not galvanize iron rod reinforcement?

Mr. Meriwether: The reason is that wire is thin and sometimes the rust gets into it before it is put into the concrete, and causes it to deteriorate. I think this should conform with the specifications for the reinforced concrete pipe.

The President: The wire, of course, is smaller, but the strain on it is slight.

Mr. Parkes: I move that the word "galvanized" be stricken out of this.

Mr. Roess: I second that.

Mr. Hallock: If you strike out "galvanized" you will have to strike out in regard to the welding also.

Mr. Meriwether: That can be taken care of by saying if galvanizing is used, it shall be welded before it is galvanized.

The Secretary: Why not simply recommend that the committee change the specifications so as to remove the idea of galvanizing?

The President: That is the import of the motion.

Mr. Roess: It seems the galvanizing, as suggested by Mr. Meriwether, is to protect it before it goes into the work. It is a question whether on these small sizes it would not be well to have it galvanized. There are times where I can see that galvanized wire would be just the thing.

Mr. Meriwether: You get a better bond with the concrete if the wire is ungalvanized, and it is better protected if it is galvanized. I think it should be left to the engineer to specify.

(*Motion carried.*)

Article 132

The Secretary: It says in the specifications that the timber shall be long leaf pine, or as specified. Do you want also to put in "commercial long leaf pine" here?

Articles 154 and 188

Mr. Parkes: With reference to measuring the sewers, the measurement with us is horizontal, and not on the line of the grade. We measure also from the middle of the main sewer out along the laterals, and I think that is the best way.

Mr. Briggs: Our practice is to make provision for the laterals in the building of the main sewers, and the measurement begins at the point where the branch is provided for. If the main sewer is a 10-foot sewer, the provision for a branch would carry it 6 or 8 feet off the center. If you paid for that additional 8 feet on a 5-foot sewer it would make quite a sum.

Mr. Van Zuben: Would it not simplify matters to measure the sewers horizontally, and then if you wanted to take into consideration the gradient, calculate the difference. If the sewer were going through a knoll in the ground, it might be difficult to measure the gradient.

Mr. Parkes: I think that specification with reference to blisters is too strict.

Mr. Meriwether: Mr. Fort has prepared a series of tests, and if a pipe is badly cracked or laminated, it cannot come up to the test.

Mr. Parkes: We must adopt a specification that can be interpreted and enforced by the engineer in the field. We have not all a laboratory to make tests with. The specifications should provide such tests that the man on the ground can test his pipe there. I move that the committee be requested to include in their specifications sufficient paragraphs to cover a physical inspection of the pipe on the ground, with the allowable defects.

Mr. Giddings: I second that.
(*Motion carried.*)

Article 164

Mr. Parkes: Is it our desire to recommend double strength pipe? Not many of us are laying it.

Mr. Rankin: I call for standard strength up to 12 inches, and above that double strength, which I think is just what they recommend there.

Mr. Parkes: I move the committee be requested to make the minimum thickness of the pipe in accordance with the so-called standard pipe.

The President: I doubt the advisability of that, unless you include the specification for both standard and double strength. There are times when the minimum sizes should be double strength, even under twelve inches. I have a piece of work on hand in which I am specifying double strength for ten and twelve, but it is heavy work with deep cuts. If the minimum is to be suggested, it had better include both. We should take into consideration that the pipe people have not as yet standardized, themselves. One will make pipe 3 feet long, another 2½ feet; one one thickness, another another. Unless they get together on their standards, and we specify certain thickness, perhaps we will be hurt when it comes to getting prices. Is it not a fact, Mr. Miller, that the western pipe and the eastern pipe differ, and that even all of the western pipes are not the same?

Mr. Miller: I think they differ.

Mr. Meriwether: I have seen some tests made in Brooklyn on 42-inch pipe, and there was three-quarters of an inch difference in two 42-inch pipes.

Mr. Parkes: You are specifying your minimum dimensions—not that you cannot have it thicker, but that you cannot have it thinner. That is the reason I want you to get commercial sized pipes. I defer to the opinions of others unless my personal experience has taught me they are wrong. I wrote my first sewer specifications in 1897, and I wrote them from a book by our secretary. I specified the pipe, and the pipe dealer could not get the pipe, and I had to amend the specifications. You must specify what you can get in the market. I expect in the small towns maybe 5 per cent of the sewers are built with standard pipe. Why specify something many are not using and what you will have difficulty in getting?

Mr. Curless: I think the specifications should fit the minimum, because you cannot get the clay alike in all parts of the country. Certain clays will not make 30-inch pipe or any thing more than 24-inches. The clays make a big difference, and the conditions in different parts of the country are, of course, different.

Mr. Meriwether: I am sure these thicknesses are going to be specified by the American Society for Testing Materials. That committee is made up of twenty, ten engineers and ten manufacturers, and representatives of nearly every pipe company in the country are on the committee.

(*Mr. Howell assumes chair.*)

Article 179

Mr. Thompson: As to gaskets, I caulk the gasket into the pipe, and then use the cement afterward.

Mr. Rankin: Another point I think should be brought out is that joints must be made by hand, that is, not using a trowel. The man uses rubber gloves and works the cement in with his fingers.

Mr. Reimer: I wish also to bring up the point of using bituminous material for jointing. Our best results were with a material manufactured in New York—I think it is called "jointite." We got less leakage than with any other material we ever used.

Mr. Roess: The question is whether the bituminous material would stand. That is a new material and works well, but whether it would not go to pieces in a few years is a question.

Mr. Reimer: I move the committee gives an expression along the line of bituminous materials for jointing pipes.

Mr. Meriwether: The committee had a clause drawn up for these bituminous materials, and there was some question as to how long it had been in use. That is the reason it was not put in the specification.

(*Motion duly seconded and carried.*)

Articles 210, 211 and 212

Mr. Meriwether: I think the allowable imperfections asked for on the vitrified pipe should go in the concrete and reinforced pipe.

Articles 190 and 202

Mr. Rankin: I move that the section referring to egg shaped flat base pipe be stricken out; that the committee be recommended to give us specifications that will omit reference to flat base and egg shaped pipe.

Article 201

Mr. Curless: I would suggest that the specification for cement concrete pipe, sizes above 4 and 6, or including those sizes, be made the same as the clay pipe specifications. I am talking about thickness. Cement pipe is made that will stand all the tests that the clay pipe will stand. Therefore the standard specifications of clay should be taken.

Mr. Meriwether: I think the committee wants to eliminate narrowing these specifications to any particular concern. They want it so that you can make pipe by hand, if necessary, and still meet the test. I do not think we should prevent a man who can get up a machine that will make a thinner pipe than could possibly be made by hand, and which will be just as strong, from doing that.

Mr. Parmley: On the point of thickness, I am opposed to setting that standard of thickness, because a different schedule has been in effect a number of years for railway culverts and water pipes; for example, on 4-foot pipe, a 4-inch thickness has been used where the pipes were transported all over the country on flat cars and handled in the same way as iron pipes. Why should you increase the thickness 25 per cent for sewers? I think if that is a minimum, it should be revised so as to place more emphasis on the strength than the thickness. I would call attention also to the fact that the present practice of the United States Government Irrigation Service in building water pipes is for thinner pipe than that. On 46-inch pipes they are using 3 inch thickness, which shows to what extremes good practice should be carried.

Mr. Curless: The United States Government, on one reclamation project in Oregon, is using 36-inch pipe with a 3-inch shell, and some of it is standing a 110-foot head at this time.

Mr. Meriwether: That is an internal pressure pipe, and has more steel, and the thickness of the concrete is simply to keep the water from getting out. The strength of the pipe is in the steel. This sewer pipe is for external pressure.

Mr. Parmley: That is correct, but the strength of that sewer does not depend entirely on concrete or steel, but the combination of the two. It is the combination and the resulting strength we desire, and not a certain amount of steel, or a certain thickness of concrete. Therefore it is not good practice to stipulate any one schedule of thicknesses.

(*The President resumes the chair.*)

The President: We should be glad to have anybody who has anything to say on these matters put it before this committee before the next meeting.

Article 248

Mr. Rankin: I never used a galvanized step in my life, and I move that "galvanized" be stricken out.

(*Motion seconded by Mr. Reimer and carried.*)

Mr. Reimer: I would suggest that the step go clear through and be lugged on the other side.

Mr. Rankin: Is there provision for paving around manholes? We find that a very necessary thing in unpaved and macadamized and even bituminous streets. Is there anything about hydraulically testing the sewer when finished? If not, I think that should be put in.

The President: The specifications will now go before the committee again with the suggested amendments and changes. In addition to that, the society urges that all who have suggestions, besides those brought out, take them up with our special sewer committee. I know they will give them full consideration. The entire discussion will, of course, be printed in the proceedings, and be in general circulation when the proceedings are out.

Mr. Chausse: I move that the President be authorized to appoint a special committee to be called the Committee on Fire Protection, said committee to be composed of three members.

(*Motion seconded by Mr. Hallock and carried.*)

EVENING SESSION

The meeting was called to order by the President at eight o'clock.

The President: The papers of Mr. Van Trump on "Effect of Traffic on Bituminous Pavements," and on "Testing Bitumens," have been printed, and if there is no objection we will pass them without reading them again.

We will next have the report of the Committee of Traffic on Streets, Mr. Howard, chairman. I will ask the secretary to read the report.

(*The secretary reads Mr. Howard's report.*)

Mr. Hallock: I would like to move the adoption of the forms and blanks as recommended by the committee on Traffic Records.

Mr. Christ: I will second that.

Mr. Rankin: This is rather a hasty action. I think it would be better to refer it back to the committee, to be published as it stands, with any suggestions that may be made here or previous to the next meeting, asking the committee to report back at the next meeting something we could adopt as standard. I will so move.

Mr. Hughes: I second that.

Mr. Hallock: I will withdraw my motion.
(*Mr. Rankin's motion carried.*)

The President: The next will be Mr. Hallock's report on the appointment of committees.

Mr. Hallock: Your committee appointed at a previous session of this convention to report on the organization of committees for the standardization of blank forms for Municipal Data and Statistics would suggest:

1. The appointment by the Chairman of this Convention of a general committee of three, each member of said committee expressing his willingness, on accepting such appointment, to serve for at least three successive years.
2. The appointment by the general committee of the following sub-committees of one member each: Street paving, street repairs and maintenance, street cleaning, street lighting, sidewalks, sewer construction, sewer maintenance, refuse collection and disposal, uniform bidding blanks, and such other sub-committees as may, in the judgment of the general committee, be necessary to secure a comprehensive set of forms for the collection of such data and statistics.

Respectfully submitted,
A. Prescott Folwell,
Maury Nicholson,
J. C. Hallock.

Mr. Fisher: I move the report be adopted.
(*Motion seconded by Mr. Christ and carried.*)

The President: We will now hear from Mr. Howell on the "Durability of Grouted Granite Pavement."

(*Mr. Howell reads his paper.*)

The President: I trust Mr. Howell will give us from time to time the result of his experiment with this kind of pavement. We should like to hear from the Committee on Street Paving.

Mr. Craig: We have not our report ready, and we should like to be permitted to prepare it and give it to the secretary. Much of the data we want we have not yet received.

The President: If there is no objection, the time asked will be granted.

The Secretary: We have received a note from Mrs. Lenderink, as follows: "Will you thank the gentlemen of the society and the entertainment committee for the beautiful flowers that came this morning. I appreciate their thoughtfulness very much."

I have also a brief paper or suggestion submitted by one of our new members, Mr. Frank Whitley. This is as follows:

MAINTENANCE BONDS FOR CITY WORK

By FRANK WHITLEY, *Hillsboro, Tex.*

A city should not ask for maintenance bonds because they are an extra expense to the city without giving value received. The standard pavements develop few defects in five years, and the city is the loser to the amount the contractor adds to his bid for maintenance. The collecting of damages from the contractor on maintenance bonds is a question that has not been settled.

The contractor does the work according to the specifications made by the city. He is always under the orders of the city engineer; he must do the work to suit him, right or wrong. The contractor has no say, therefore I do not think under these conditions he is liable.

If cities construct the cheaper class of pavements they should not ask for maintenance bonds. These cheap pavements are new and untried; the probable cost of maintenance is all guess work; the careful contractor will always guess enough, the cities therefore are paying for an unknown expense.

There is another question that has not been settled—as to the legality of assessing the extra amount the contractor adds to his bid for the five years maintenance, when cities have adopted the front foot plan, which assesses part of the cost against the property owner. The law requires cities to keep the streets in repair; therefore I do not think cities can charge the property owner for more than the actual amount of the cost of constructing pavements. If cities let their contracts only to reliable contractors, the cost of maintenance will be a nominal amount.

MR. HALLOCK: The report of the committee just adopted on standard forms provided that the chairman of this convention appoint a committee of three. In case they are appointed here, they might have a meeting before they separate.

Another matter was brought to my attention this morning in connection with the sewer specifications. We have in our specifications several times repeated the specification for cement. I do not know whether it coincides with either the specifications of the American Society of Civil Engineers or the Society for Testing Materials, but I think it proper that this convention suggest to our committee on specifications that we adopt between now and the next convention some standard cement specifications, one of those adopted by the other organizations being preferable; but at all events that they recommend some standard specifications that we can use by simply mentioning it. I would like to move that such a suggestion be made to the committee on Standard Specifications.

(*Seconded by Mr. Christ and carried.*)

MR. CHRIST: The Association for Standardizing Paving Specifications adopted the specifications of the Society for Testing Materials.

MR. HALLOCK: In conversation with some of the members of the nominating committee, it was brought to my attention that the committee selected each year to suggest officers for the society works more or less in the dark as to the qualifications of the men. One of the committee made the suggestion that there might be a record kept of the work or activity of each member of the society; in other words, if they might have placed before them the record of each man—the number of conventions he had attended, his terms of service on committees, the number of papers presented—such information would be of help to the nominating committee. I fear we are beginning to fall into some sort of a rut in pushing up the officers of our society. That is not always the best thing to do. I would like to move that the secretary be requested to compile from the data he has on hand a record of the existing membership, and that at the next convention he suggest to us a method for continuing this record.

(*Motion seconded by Mr. Giddings and carried.*)

Mr. Briggs: I would suggest the chair now appoint the new committee of three.

The President: I shall appoint Mr. Hallock, Chairman, Mr. Folwell and Mr. Nicholson.

Mr. Wadsworth: In the proceedings today the reports of the committees have been accepted, subject to reporting back a standard for the next meeting, and I would suggest that the report of the Creosote Wood Block Specification Committee be acted on in the same way, because we are all working towards standards of construction and treatment of wood block pavement, and I believe next year the experiments that are going on will enable us to recommend a specification for treatment and construction of creosote wood block pavement that we can give out as standard.

The President: The older standing committees on standard specifications have reported, and their reports have all been accepted. The sewer committee reported an absolutely new specification, and that is the only one not accepted and adopted by the Society. That was referred back to the committee because it was new and there was a limited time for discussion and because the committee were absent.

Mr. Collier: The wood block specifications were not adopted last year, and it occupies almost the same position with reference to this society that your sewer report does. We have been one year without specifications adopted by this society. The specifications were hurriedly adopted, and they are not satisfactory to the wood block people. I presume it is the desire of the association to perfect these specifications as rapidly as possible and get as good a specification as is possible. We had much rather that specification not leave here as the sentiment of the society, but that it be left to be discussed in the same way as the sewer specifications.

Mr. Dow: These specifications are not permanent, but are meant to be corrected and revised each year. If there are any comments, they should be written, and the committee can take them into consideration during the year. The specifications were considered the best we were capable of writing at the present time.

The President: The society desires that the different people interested in the different specifications furnish to the committees during the year all the information they desire to have considered.

The next will be a paper by Mr. James E. Howard, of the Bureau of Standards, Washingon, D. C., on "Thermal Effects on Cement-Filled Brick Pavements."

(Mr. Howard reads his paper.)

The President: I will now ask the secretary to read the paper of Mr. McCabe, of Detroit.

(The secretary reads Mr. McCabe's paper.)

Mr. Anderson: I would like to move that the president appoint a committee of two to extend the appreciation and thanks of this society for the treatment that has been accorded us at this convention in Dallas.

(Motion seconded by Mr. Giddings and carried.)

The President: I will appoint Messrs. Anderson and Christ.

I think this has been one of the most successful meetings we have held. Our sessions have been better attended than ever before. A number of our active members have commented upon that fact. The papers have been listened to with much interest, and the subjects have been well handled in the discussions. We have enjoyed every minute of our stay in Dallas, and I want again to thank you for the honor you conferred on me in selecting me as your president. I feel it is the crowning honor a municipal engineer can aspire to; I know of no honor that could be conferred upon me that I would appreciate more than that one. I appreciate your attendance at this convention and your hearty support in everything we have tried to do. This convention has been a success; we have worked hard, we have stayed together, and I believe we have accomplished great good. I am exceedingly proud of this Dallas meeting and of the part I have played, and which you have helped me to play in making it a success. We owe a great deal to Mr. Dalton for his energy, assisted by Mr. Preston and Mr. Johnson. Special attention also should be called to the services rendered us by the Dallas *News*. The other papers have treated us well, but the *News* has had this young man here at every session, and he has treated us very well, and so has his paper.

I think we should hear from the incoming president.

Mr. Briggs: I can only say that I fully appreciate the honor conferred on me in being chosen president for the coming year, and I shall endeavor to make the coming year a success, with the assistance of the secretary and the other officers.

The Secretary: I want to say that I have been secretary five years now, and I do not think I ever knew of any president to work harder than Mr. Kingsley has.

The President: This closes the program for this convention of the society, and I now declare the convention closed.

RESOLUTION OF APPRECIATION AND THANKS

Dallas, Texas, November 15, 1912.

Be It Resolved by the American Society of Municipal Improvements assembled in the nineteenth annual convention at Dallas, Texas.

That this meeting has been the most delightful and successful in the history of this association, and that the appreciation and thanks of this society be extended to the following:

To the local Entertainment Committee, Messrs. E. L. Dalton,

J. M. Preston, and A. H. Johnson for their labors and untiring efforts in entertainment for the society, which contributed largely to the pleasure of our visit in Dallas.

To Mesdames Dalton, Preston, Irving, Smith, and Alexander for courtesies, and entertainment extended by them to visiting ladies.

To the Dallas Chamber of Commerce, the Dallas Automobile Club, and the Golf Club, for courtesies extended to members of this society, and their ladies upon the inspection tour about the City.

To Mr. Frank B. Dunn for floral decorations in the convention hall.

To the United States Government for beginning the scientific study of the behavior of street pavements through its Bureau of Standards.

To the local press of Dallas for notice, and especially to Mr. C. Du Bose representing the Dallas *News* who has attended every session, and so ably presented our proceedings to the citizens of Dallas.

To the officials and citizens of Dallas for their hospitable welcome.

Be it further resolved that as we return to our respective homes we take with us the spirit of progress and enterprise exhibited by the City of Dallas, and which appears to be characteristic of other Municipalities in the great State of Texas.

CLARK G. ANDERSON,
E. H. CHRIST,
Committee.

Group of Members at the Dallas Convention

REGISTERED AT DALLAS CONVENTION

Ahlers, Dr. O. C.
Allen, F. R.
Anderson, Clark G.

Baker, E. M.
Bakup, John
Blackmer & Post Pipe Company
Blair, Will P.
Bradshaw, H. J.
Brennan. W. C.
Briggs, B. E.
Brown, Matthew
Brown, Miss Elizabeth
Burdge, J. S.
Burns, B. M.

Campbell, A. M. Jr.
Chausse, Alcide
Christ, E. H.
Christy, Leslie V.
Colby, Elmer E.
Colby, Mrs. Elmer E.
Collier, H. L.
Cottam, C. M.
Couch, Eugene
Craig, George W.
Craig, Mrs. George W.
Crook. J. W.
Curless, Theo. A.
Cutter, Frank G.

Dalton, E. Leon
Danford, W. P.
Dickey, A. T.
Dow, A. W.

Ewart, Chas. W.

Fisher, E. A.
Fisher, Mrs. E. A.
Flenniken, John W.
Folwell, A. Prescott
Franklin, H. B.
Fuller, Claude E.

Gardiner, W. H. R.
Gates, C. A.
Giddings, Fred
Goetz, A. L.
Goodfellow, J. J.
Granger. B. F.

Hall, Kirk
Hallock, J. C.
Hamnett, W. S.
Hanna, R. T.
Hawley, John B.
Head, J. M.
Howell, William A.
Hughes, T. C.
Hunter, W. B.
Hyams, R. M.

Ingram, G. M.
Iredell, George S.

Johnson, A. H.
Johnson, S. L.

Kaull, P. S.
Kemp, L. W.
Kempster, T. G.
Kingsley, E. A.
Kingsley, Mrs. E. A.
Kinn, J. G.
Klein, A. K.
Klein. I. K.

Lake, Joe Jr.
Law, Robert E.
Lenderink, A.
Lenderink. Mrs. A.
Leonard. C. E.

Macallum, A. F.
Macartney, Morton
Manning, F. S.
Maurer, A. P.
Meade, R. E.
Meriwether, B. B.
Meriwether, Coleman
Milam, R. W.
Miller, B. F.
Murginondo, F.
Murphy, Matthew D.
Myers, George
McCabe, J. C.
McCudden, A. J. Jr.

Naberhuis, H. A.
Nicholson, Maury
Nicol, W. H.
Noble, O. E.

Parkes, Wm. J.
Parkes, Mrs. Wm. J.
Parkes, Master Ed.
Parmley, W. E.
Payton, Lyle
Phelps, S. H.
Phelps, Mrs. S. H.
Pierce, John I.
Pillman, C. H.
Powell, W. J
Preston, J. M.
Pullar, H. B.

Rankin, Edward S.
Rankin, Miss Edith J.
Reed, Merle H.
Reimer, Frederick A.
Reimer, Mrs. Frederick A.
Richardson, Clifford
Ruttan, C. H.
Robinson. E. M.
Roess, G. F.
Rudolph, Charles A.

Smith, W. H. Buck
Smith, Francis P.
Somers, A. M.
Sonners, R. M.
Sparks, Geo. W.
Stallings, Robt.
Stubbs. R. C.

Thompson, A.
Thompson, J. Edgar
Thurston, G. W.
Truett, Geo. W.

Van Zuben, F. J.

Wadsworth, Chas. S.
Ward, L. M.
Warren, Geo. C.
Waters, J. D.
Weston, W. S.
Whitley, Frank
Wilson, James
Winchester, Mark
Wooden, F. M.

York, C. V.

GROUP OF MEMBERS AT THE DALLAS CONVENTION

CONSTITUTION OF THE SOCIETY

ARTICLE I—NAME AND OBJECT

Section 1. The objects of this Society, which shall be known as "The American Society of Municipal Improvements," shall be to disseminate information and experience upon, and to promote the best methods to be employed in the management of municipal departments, and in the construction of municipal works, by means of annual conventions, the reading and discussion of papers upon municipal improvements, and by social and friendly intercourse at such conventions; and to circulate among its members, by means of an annual publication, the information thus obtained.

ARTICLE II—MEMBERSHIP

Section I. Any engineer, officer or director who shall have charge or supervision over, or be employed as a consulting engineer on any public municipal department work, or any mayor, councilman or other municipal official in any municipality, is eligible to active membership in this Society.

Any member who shall have ceased to have charge or supervision of any public or municipal department or work may retain his active membership, unless he shall have come under the restrictive requirements of associate membership, when he shall retain membership as an associate only. Decision as to the classification or change in classification of all members shall rest with the Executive Committee; but an appeal may be taken from such decision to the Society at any regular annual meeting.

Sec. 2. Every application for membership shall be in writing, stating the age and residence of the applicant, his official position and past experience in municipal work.

Every application shall be considered by the Executive Committee within two months of its receipt by the Secretary. A two-thirds vote of the committee shall be necessary for election. In case of the rejection of an applicant by the committee, he may appeal to the Society at the next annual convention, when a two-thirds vote of all the active members voting shall admit him to membership. Election shall take effect upon the payment of the dues to the end of the current year.

Sec. 3. Any proper person interested in municipal improvements or work as a contractor or contracting agent or who is a manufacturer of or dealer in municipal supplies, may become an associate member, who shall enjoy all the rights and privileges of active membership, excepting that of holding office, voting or addressing the convention without its consent.

Sec. 4. Any one interested in the subject of municipal improvements, but not included in either of the above classes of members, may be admitted as an affiliated member. Such members shall enjoy all the rights and privileges of active membership, excepting that of holding office or voting.

Sec. 5. Any member who shall be in arrears for more than one year's dues may be considered as no longer a member of this Society, and his name may be discontinued from the roll of the Society at the discretion of the Executive Committee.

Sec. 6. Any member may withdraw from the Society upon payment of all dues to date, and by notifying the Secretary thereof in writing.

Sec. 7. Any member may be expelled from the Society at a regular meeting of the same, upon the recommendation of the Executive Committee, adopted by a two-thirds vote of all the active members voting.

ARTICLE III—Fees and Dues

Section 1. Each active and each affiliated member shall pay five dollars per annum, and each associate member shall pay ten dollars per annum, all dues to be payable in advance, on or before the date of the annual meeting; except that if more than one representative of a given company be members, one shall pay a fee of ten dollars, and the others five dollars each. A member admitted after March 15th of any year shall pay, for the balance of that year, one-half the annual dues.

ARTICLE IV—Officers

Section 1. The officers of this Society shall consist of a President, three Vice-Presidents, a Secretary, and a Treasurer, not more than two of whom shall be residents of the same state; and who, with the past Presidents who have retained their continuous membership, shall act as an Executive Committee for and in behalf of the Society.

Sec. 2. There shall also be elected a Finance Committee consisting of three members of the Society.

Sec. 3. In case of any of the above positions, excepting the Presidency, becoming vacant, or in case of their absence during the annual convention, the President shall fill such vacancy by appointment from the membership.

Sec. 4. There shall be appointed annually the following standing committees:

1. Street Paving.
2. Street Lighting.
3. Waterworks and Water Supply.
4. Sewerage and Sanitation.
5. Refuse Disposal and Street Cleaning.
6. Park Development and Maintenance.
7. Municipal Government and Finance.
8. Standard Forms and Records.

9. Standard Specifications.
10. Convention Papers.
11. Convention Arrangements.

The chairman of the last named committee shall be a resident of the city in which the next following convention is to be held, provided there is a member of the Society residing in that city. The Secretary of the Society shall be the Chairman of the Committee on Convention Papers, and may name two or more additional members of said committee.

The number of each committee shall be three, and the chairman may add such names as he may deem advisable. No special or standing committee shall be authorized to create any liabilities unless the same shall have been first approved by the Executive Committee.

ARTICLE V—Elections

Section 1. The officers of this Society shall be elected by ballot on the second day of each annual convention, a majority of the votes cast electing.

Sec. 2. The President shall not be eligible for immediate re-election (except by a unanimous vote).

Sec. 3. The officers elected shall assume office immediately after the close of the annual meeting at which they were elected.

Sec. 4. The ballot for any officer may be waived by unanimous consent.

ARTICLE VI—Duties

Section 1. The President shall preside at the meetings of the Society and at those of the Executive Committee, and shall perform such other duties as are incumbent upon the office. In the absence of the President, or upon his becoming ineligible, the senior Vice-President shall assume and perform the duties of the office.

Sec. 2. The Secretary shall keep accurate minutes of the proceedings of the Society and of the Executive Committee; shall conduct all correspondence; shall issue notices of any meeting of the Society not less than four weeks prior to the date of such meeting; shall collect and receipt for all fees and dues and pay them to the Treasurer, taking his receipt for the same; and keep accurate account between the Society and its members.

He shall keep an accurate list of the members of the Society, and take such steps as may be necessary to secure new nembers—this with a view of insuring the permanency of the association, as well as maintaining and increasing the membership thereof.

The Secretary shall receive a salary, the amount of which shall be determined by the Executive Committee. In addition, his expenses incurred in attending conventions of this Society shall be paid by the Society; and he is authorized to incur, in the name of the Society, the expenses necessary to the conduct of his office, including an assistant during the convention.

Sec. 3 The Treasurer shall receive from the Secretary and safely keep all moneys belonging to the Society, giving his receipt therefor; shall pay all bills by vouchers countersigned by the President and Secretary; shall keep correct account of the funds of the Society, and submit to it at its annual meeting a report of all receipts and disbursements during the preceding year.

Sec. 4. The Executive Committee shall manage all the affairs of the Society, subject to the action and approval of the Society at its meetings. All questions in Executive Committee shall be decided by a majority vote, and five members shall constitute a quorum, not less than four of whom shall be officers of the Society. The Executive Committee shall meet at least once each year, on the morning of the first day of the annual meeting of the Society, and as much oftener as the President may determine.

Sec. 5. The Finance Committee shall meet on the morning of the first day, and previous to the annual meeting of the Society, to examine and audit the Secretary's and Treasurer's accounts and annual statements, and report thereon to the Society.

Sec. 6. It shall be the duty of each of the standing committees, Nos. 1 to 9, inclusive, to prepare a report and submit the same at the annual meeting. Also to obtain, for presentation at the meetings, papers on the subjects covered by said committee. The Committee on Convention Papers shall exercise such supervision over the papers presented as may be defined by the by-laws. The Committee on Convention Arrangements shall have charge of the details of the convention next following the appointment of said committee, subject to the provisions of this Constitution, the By-Laws and the instructions of the Executive Committee.

ARTICLE VII—Meetings

Section 1. The annual meeting of the Society shall be held in such city as the majority of the members voting shall decide; selection of place of meeting to be made after the officers shall have been elected. The date and duration of the meeting shall be determined by the Executive Committee, which shall notify the members concerning the same not later than the first of June; but such date shall be in either September, October or November.

Sec. 2. At any annual meeting of the Society twenty members shall constitute a quorum for the transaction of business.

Sec. 3. Any member, with the concurrence of the presiding officer, may admit friends to the meeting of the Society; but such person or persons shall not without the consent of the meeting be permitted to take part in any discussion.

Sec. 4. All papers, drawings, etc., submitted to the meeting of the Society shall be and remain the property of the Society.

ARTICLE VIII—ORDER OF BUSINESS

Section 1. At the annual meeting of the Society the order of business at the first session shall be as follows:

1. The President's address.
2. Reports of the Secretary and Treasurer.
3. Report of the Executive Committee.
4. Report of the Finance Committee.
5. Reports of Special Committees.
6. Reading and Discussion of Papers.

Election of officers and selection of the place of meeting shall take place during the second day.

Sec. 2. All questions shall be decided by vote, and all differences of opinion in regard to points of order shall be settled by parliamentary practice as set forth in Cushing's Manual.

ARTICLE IX—AMENDMENTS

Section 1. The foregoing constitution and articles may be amended on or after the second day of any annual meeting of the Society by a two-thirds vote of all members voting; provided such proposed amendment shall have been submitted to the Society in writing on the first day of its annual meeting.

BY LAWS

No. 1. Papers presented by active members shall be submitted to the Committee on Convention Papers prior to presentation, which committee shall have the right to edit the same, but shall not have the right to exclude any paper entirely. Papers presented by associate members shall be submitted to the Committee on Convention Papers for approval and editing prior to the convention for which they are offered. Associate members may speak personally on the floor of the convention by consent of the members present.

No. 2. Members shall not be permitted to give out for publication any papers, to be submitted to the Society at its annual meeting, in advance of such meetings; and all requests for papers for such purposes shall be referred to the Secretary.

OFFICERS OF THE SOCIETY FOR THE YEAR 1912–1913

President	B. E. BRIGGS	Erie, Pa.
First Vice-President	EDWARD H. CHRIST	Grand Rapids, Mich
Second Vice-President	WILLIAM A. HOWELL	Newark, N. J.
Third Vice-President	A. F. MACALLUM	Hamilton, Ont.
Secretary	A. PRESCOTT FOLWELL	New York, N. Y.
Treasurer	E. L. DALTON	Dallas, Tex.

Finance Committee

E. S. RANKIN, *Chairman*	Newark, N. J.
L. V. CHRISTY	Wilmington, Del.
E. E. COLBY	Chickasha, Okla.

Executive Committee

The officers of this Society, together with the Past Presidents who have retained their continuous membership, constitute the Executive Committee. The Past Presidents are as follows:

Past Presidents

M. J. MURPHY	St. Louis, Mo.
GEORGE H. BENZENBERG	Milwaukee, Wis.
AUGUST HERRMANN	Cincinnati, Ohio
HARRISON VAN DUYNE	Newark, N. J.
NELSON P. LEWIS	New York, N. Y.
A. D. THOMPSON	Peoria, Ill.
ROBERT E. McMATH	St. Louis, Mo.
E. A. FISHER	Rochester, N. Y.
C. H. RUST	Toronto, Canada
GEORGE M. BALLARD (Deceased)	Newark, N. J.
A. PRESCOTT FOLWELL	New York City
CHARLES C. BROWN	Indianapolis, Ind.
MORRIS R. SHERRERD	Newark, N. J.
GEORGE W. TILLSON	Brooklyn, N. Y.
JAMES OWEN	Newark, N. J.
JULIAN KENDRICK	Birmingham, Ala.
FRED GIDDINGS	Atchison, Kan.
E. A. KINGSLEY	Little Rock, Ark.

OFFICIALS
FOR THE YEAR
1912-1913

President, **B. E. BRIGGS**

First Vice-President
E. H. CHRIST

Third Vice-President
A. F. MACALLUM

Second Vice-President
W. A. HOWELL

Secretary
A. PRESCOTT FOLWELL

Treasurer
E. L. DALTON

STANDING COMMITTEES

1912–1913

Street Paving

GEO. W. CRAIG, *Chairman*	Omaha, Neb.
E. E. COLBY	Chickasha, Okla.
F. J. CELLARIUS	Dayton, O.

Traffic on Streets

JAS. W. HOWARD, *Chairman*	New York, N. Y.
LINN WHITE	Chicago, Ill.
LOUIS L. TRIBUS	New York, N. Y.

Street Lighting

J. E. PUTNAM, *Chairman*	Rochester, N. Y.
F. G. LYNCH	Erie, Pa.
J. M. PRESTON	Dallas, Tex.

Water Works and Water Supply

A. F. MACALLUM, *Chairman*	Hamilton, Ont.
J. WALTER ACKERMAN	Auburn, N. Y.
G. F. ROESS	Oil City, Pa.

Sewerage and Sanitation

FREDERIC A. REIMER, *Chairman*	Newark, N. J.
ALEXANDER POTTER	New York, N. Y.
FREDERIC R. CHARLES	Richmond, Ind.

Garbage Disposal and Street Cleaning

J. T. FETHERSTON, *Chairman*	New York, N. Y.
J. EDGAR THOMPSON	Knoxville, Tenn.
B. F. MILLER	Meadville, Pa.

Park Development and Maintenance

H. S. RICHARDS, *Chairman*	Chicago, Ill.
R. J. EDGERLY	Albany, Ga.
JOSEPH FIRTH	Charlotte, N. C.

Municipal Legislation and Finance

WM. J. PARKES, *Chairman*	Pine Bluff, Ark.
C. W. EWART	Aberdeen, Wash.
S. H. PHELPS	Sharpsville, Pa.

Standard Forms

J. C. HALLOCK, *Chairman*	Newark, N. J.
A. PRESCOTT FOLWELL	New York, N. Y.
MAURY NICHOLSON	Birmingham, Ala.

Sub-Committees on Standard Forms

STREET PAVING AND REPAIRS

G. W. TILLSON, New York, N. Y.

SIDEWALKS AND CURBS

PROF. A. N. TALBOT, Urbana, Ill.

STREET CLEANING AND REFUSE DISPOSAL

J. T. FETHERSTON,
Richmond Boro, New York, N. Y.

SEWER CONSTRUCTION AND MAINTENANCE

GEO. A. CARPENTER,
Pawtucket, R. I.

STREET LIGHTING

GEORGE A. SAWIN, Newark, N. J.

UNIFORM BIDDING BLANKS

E. H. CHRIST, Grand Rapids, Mich.

Standard Specifications

CHARLES CARROLL BROWN, *Chairman*	Indianapolis, Ind.
JAMES OWEN	Newark, N. J.
CHARLES H. RUST	Victoria, B. C.
MORRIS R. SHERRERD	Newark, N. J.
E. A. FISHER	Rochester, N. Y.

Sub-Committees on Standard Specifications

WOOD BLOCK PAVING

J. N. HAZLEHURST, *Chairman*
JAMES E. BARLOW
H. W. KLAUSMANN

BRICK PAVING

E. H. CHRIST, *Chairman*
HENRY MAETZEL
F. J. CELLARIUS

BITUMINOUS PAVING

LINN WHITE, *Chairman*
A. H. BLANCHARD
W. W. SOUTHGATE

ASPHALT PAVING

GEORGE W. CRAIG, *Chairman*
FRANCIS P. SMITH
WILLIAM A. HOWELL

CONCRETE PAVING

F. R. CHARLES, *Chairman*
F. D. BROWN
C. G. ANDERSON

SEWERS

E. J. FORT, *Chairman*
RUDOLPH HERING
A. J. PROVOST

STONE BLOCK PAVING

J. C. HALLOCK, *Chairman*
J. HERBERT GRANT
HENRY MAETZEL

MACADAM AND GRAVEL ROADS

A. H. BLANCHARD, *Chairman*
F. A. REIMER
W. W. CROSBY

Fire Prevention

ALCIDE CHAUSSE, *Chairman*	Montreal, Can.
NORMAN S. SPRAGUE	Pittsburg, Pa.
L. C. WILLIS	Dallas, Tex.

Convention Papers

A. PRESCOTT FOLWELL, *Chairman*	New York, N. Y.
GEO. W. TILLSON	Brooklyn, N. Y.
JOHN M. GOODELL	Upper Montclair, N. J.

Convention Arrangements

L. V. CHRISTY, *Chairman*	Wilmington, Del.
ALEXANDER J. TAYLOR	Wilmington, Del.
W. C. BRENNAN	Hamilton, Ont.

Convention Exhibits

H. L. COLLIER, *Chairman*	St. Louis, Mo.
J. MERRICK HORN	Wilmington, Del.
FRANK B. DUNN	Conneaut, O.
W. C. PARMLEY	New York, N. Y.

LIST OF MEMBERS

Active members

	Membership Dates From
ACKERMAN, J. WALTER, Superintendent, Board of Water Commissioners, Auburn, N. Y.	1905
ALDRIDGE, WILLIAM, Chief Computer and Estimator, City Engineering Dept., 33 McGee St., Winnipeg, Man.	1912
ALEXANDER, A. B., City Engineer, Decatur, Ill.	1910
ALLEN, F. R., City Engineer, Pine Bluff, Ark.	1911
ALLEN, HENRY C., City Engineer, Syracuse, N. Y.	1908
ALLIN, THOS. D., 203 Kendall Bldg., Pasadena, Cal.	1905
ALVORD, JOHN W., Consulting Engineer, Hartford Bldg., Chicago, Ill	1899
AMBLER, JOHN N., Consulting Engineer for City, Winston, N. C.	1908
ANDERSON, CLARK G., Commissioner of Streets and Public Improvements, Moline, Ill.	1908
ANDREWS, HORACE, 125 Lancaster St., Albany, N. Y.	1898
ASH, LOUIS R., City Engineer, City Hall, Kansas City, Mo.	1911
ASHLEY, CHAS. S., Mayor, New Bedford, Mass.	1912
ASTLEY, JOHN W., Engineer of Construction for City, 714 Broadway, Winnipeg, Man.	1912
BAILLAIRGE, W. D., City Engineer, Quebec	1912
Baker, HENRY E., Watertown, N. Y.	1905
BALTZER, AUGUST, City Engineer, 783 Market St. Kenosha, Wis.	1912
BARKER, HARRY T., City Engineer, New Brighton, Pa.	1910
BARLOW, JAMES E., Engineer, Bureau of Municipal Research, 911 Neave Bldg., Cincinnati, O.	1910
BARLOW, JOHN R., City Engineer, Montreal, Canada	1902
BAUMGARTNER, CHARLES H., City Engineer, Dubuque Ia.	1910
BAYLISS, J. R., 704 Farley Bldg., Birmingham, Ala.	1911
BEAN, W. IRVING, City Engineer, Terrell, Texas	1912
BENZENBERG, GEO. H., 1310 Wells Bldg., Milwaukee, Wis.	1894
BERRY, GEORGE, Asst. Engineer, Bureau of Highways, Brooklyn, N. Y.	1905
BINGHAM, CLARENCE A., Borough Engineer, Carlisle, Pa.	1908
BLAIR, BRYCE R., Carbondale, Pa.	1905
BLAIR, M. W., Kushequa, Pa.	1910
BLANCHARD, A. C. D., City Engineer, Lethridge, Alberta, Canada	1912
BLANCHARD, ARTHUR HORACE, Professor of Highway Engineering, Columbia University, New York City	1909
BRADSHAW, H. J., City Engineer, Abilene, Texas	1912

	Membership Dates From
Brennan, W. C., Secretary City Corporation, Hamilton, Ont.	1909
Briggs, B. E., City Engineer, Erie, Pa.	1902
Briggs, H. E., 659 Walker St., Milwaukee, Wis.	1911
Brown, Charles Carroll, Editor *Municipal Engineering*, 702 Wulsin Bldg., Indianapolis, Ind.	1895
Brown, Frank D., City Engineer, Shawnee, Okla.	1908
Brown, Matthew, City Engineer, 211 S. State St. Emporia, Kan.	1911
Brown, Thurber A., 416 E. Church St., Elmira, N. Y.	1908
Buchanan, N. B., Resident Engineer, Cullman Coal and Coke Co., Huntsville, Ala.	1909
Buck, Lucien, Mechanical Engineer, Champion Fibre Co., Canton, N. C.	1909
Bull, Irving C., Care Bull & Roberts, 100 Maiden Lane, New York City	1912
Butler, Morgan R., City Engineer, Waukesha, Wis.	1911
Campbell. W. C., Superintendent Public Works, Columbus, Ga.	1907
Carpenter, George A., City Engineer, Pawtucket, R. I.	1905
Carter, Hugh R., Assistant City Engineer, Little Rock, Ark.	1909
Cellarius, Frederick J., City Engineer, Rm. 8, City Bldg., Dayton, O.	1910
Chausse, Alcide, City Architect and Superintendent of Buildings, 1433 Hubert Street, Montreal, Canada	1901
Charles, Frederic R., City Engineer, Richmond, Ind.	1910
Christ, Edward H., Grand Rapids, Mich.	1908
Christy, L. V., Secretary Street and Sewer Dept., Wilmington, Del.	1903
Clark, Alfred, Commissioner of Highways, Concord, N. H.	1908
Codwise, Edward B., 298 Wall St., Kingston, N. Y.	1906
Colby, Elmer E., City Engineer, Chickasha, Okla.	1909
Cole, Howard J., 161 Claremont Ave., Montclair, N. J.	1909
Collins, Clarke P., Civil and Mining Engineer, 809–811 Johnstown Trust Bldg., Johnstown, Pa.	1909
Collins, John L., Village Engineer, Saranac Lake, N. Y.	1910
Connolly, P. H., City Engineer, City Hall, Racine, Wis.	1908
Coombs, Philip H., City Engineer, Bangor, Me.	1912
Cooper, Sam'l. L., City Engineer, Yonkers, N. Y.	1908
Corning, Dudley T., Assistant to Mining Engineer, C. S. Co., Westmont, Johnstown, Pa.	1909
Corson, S. Cameron, Borough Engineer, City Hall, Norristown, Pa.	1908
Couch, Eugene, Consulting Engineer, Dallas, Texas	1909
Craig, George W., City Engineer, City Hall, Omaha, Neb.	1911
Crayton, G. A., City Engineer, Lima, O.	1912
Crook, J. W., City Engineer, 1704 Lamar Ave., Paris, Texas	1912
Crosby, Walter W., State Highway Engineer of Maryland, care Johns Hopkins University, Baltimore, Md.	1909

	Membership Dates From
Curfman, Lawrence E., City Engineer, Pittsburg, Kan.	1910
Cutcheon, L. D., City Engineer, Grand Rapids, Mich.	1906
Dalton, E. L., Juanita Bldg., Dallas, Texas	1906
Danford, W. P., City Engineer, Durant, Okla.	1912
Davis, Charles, H., 18 Old Slip, New York City	1911
DeLay, Theo. S., City Engineer, Creston, Ia.	1910
Denman, A. R., Chairman, Department of Water, Board of Street and Water Commissioners, 765 Broad St., Newark, N. J.	1906
Dickey, A. T., City Engineer, Galveston, Texas	1912
Dingle, James H., City Engineer, City Hall, Charleston, S. C.	1908
Doughty, Joshua, Jr., County Engineer, Somerville, N. J.	1908
Douthitt. M. J., City Engineer, City Hall, Waukegan, Ill.	1911
Dow, A. W., 24-26 E. 21st. St., New York City	1906
Drowne, Henry B., Instructor in Highway Engineering, 210 Hartley Hall, Columbia University, New York City	1912
Earl, George G., General Superintendent, Sewerage and Water Board, New Orleans, La.	1906
Edgerly, R. J., City Engineer, Albany, Ga.	1908
Ellsworth, Frank V. P., Hot Springs, Ark.	1908
Elsner, Richard E., City Engineer, Cadillac, Mich.	1911
Elwood, F. T., Commissioner Public Works, Rochester, N. Y.	1907
English, Jos. E., Assistant Engineer, Department of Streets, Trenton, N. J.	1912
Erwin, M. C., Office Engineer, O'Neill Engineering Co., Dallas, Texas.	1908
Ewart, Charles W., City Engineer, Aberdeen, Wash.	1910
Fetherston, J. T., Engineer of Street Cleaning, Borough of Richmond, 16 Lenox Place, New Brighton, N. Y.	1911
Fewell, J. H., Engineer and Superintendent Water Works, Jackson, Miss.	1912
Finch, B. K., City Engineer, Wilkes-Barre, Pa.	1908
Firth, Joseph, City Engineer, Charlotte, N. C.	1908
Fisher, E. A., City Engineer, Rochester, N. Y.	1896
Flenniken, John W., Commr. Streets and Public Improvements, Knoxville, Tenn.	1912
Fletcher, Austin B., Highway Engineer, Forum Bldg., Sacramento, Cal.	1912
Floyd, William H. **Jr.,** 413½ Francis St., St. Joseph, Mo.	1905
Folwell, A. **Prescott,** Editor *Municipal Journal*, 50 Union Square, New York City	1901
Fort, E. J., Chief Engineer of Sewers, Borough of Brooklyn, N. Y.	1905
Freiberg, M. J., Waterworks Commission, 216 E. Front St. Cincinnati, O.	1898

	Membership Dates From
Freitas, Geo. H., City Engineer, Modesto, Cal.	1913
Freshney, S. A., General Manager, Grand Rapids Muskegon Power Co., Grand Rapids, Mich.	1905
Fuller, George W., 170 Broadway, New York City	1906
Gainey, W. H., City Engineer, Valdosta, Ga.	1906
Gardiner, W. H. R., Superintendent Public Works, 627 15th Ave., West Calgary, Alta.	1912
Gardner, S. B., City Engineer, Eldora, Ia.	1910
Garland, E. A., City Engineer, Santa Barbara, Cal.	1912
Gavett, Andrew J., City Surveyor, Plainfield, N. J.	1910
Gaynor, Keyes C., City Engineer, Sioux City, Ia.	1911
Giddings, Fred, 316 Godchaux Bldg., New Orleans, La.	1896
Gilchrist, Allen R., City Engineer, Montgomery, Ala.	1906
Giles, John, A., City Engineer, Binghampton, N. Y.	1911
Gillespie, Richard H., Chief Engineer Sewers and Highways, 2774 Briggs Ave., Bronx, New York City	1912
Goodell, John M., 106 Lorraine Ave., Upper Montclair, N. J.	1904
Goodfellow, J. J., City Engineer, San Angelo, Texas	1912
Grant, Justus H., Special Assistant City Engineer, Rochester, N. Y.,	1908
Green, W. W., City Engineer, Helena, Ark.	1911
Greenalch, Wallace, Commissioner of Public Works, Albany, N. Y.	1908
Gregory, Alfred C., Engineer of Sewers, 907 Bellevue Ave., Trenton, N. J.	1910
Griffin, J. William, Superintendent of Water, City Hall, Jersey City, N. J.	1909
Griggs, Julian, Columbus, O.	1904
Grimes, Edwin L., City Engineer, Troy, N. Y.	1908
Hackney, John W., Atlantic City, N. J.	1908
Hale, Elson,	1909
Hall, Edmund, Rm. 5, Kistner Bldg., Granite City, Ill.	1908
Hallock, James C., Deputy Chief Engineer, City Hall, Newark, N. J.	1909
Halsey, Edmund R., 41 Delaware Ave, South Orange, N. J.	1908
Hammett, W. S., Mgr., Pittsburgh Testing Laboratory, 305 Praetorian Bldg., Dallas, Texas	1912
Hammond, Geo. T., 156 Berkeley Place, Brooklyn, N. Y.	1908
Harder, H. J., City Engineer, City Hall, Paterson, N. J.	1909
Harding, Robert J., Superintendent of Public Works, Poughkeepsie, N. Y.	1910
Harper, E. A., Kansas City, Mo.	1905
Harris, Harry F., Engineer of Streets, Trenton, N. J.	1910
Hatton, T. Chalkley, Wilmington, Del.	1903
Haussling, Jacob, Mayor, Newark, N. J.	1907
Hawkins, A. J., Assistant Engineer, City Hall, N. Birmingham, Ala.	1910

	Membership Dates From
Hawley, John B., Hoxie Bldg., Ft. Worth, Texas	1912
Hazlehurst, James Nisbet, 532 Candler Bldg., Atlanta, Ga.	1903
Hegarty, D. A., Manager, New Orleans Railway & Light Co., New Orleans, La.	1909
Hellen, H. H., City Engineer, Wagoner, Okla.	1909
Henry, P. W., 25 Broad St., New York City	1906
Hering, Rudolph, 170 Broadway, New York City	1910
Herrman, August, President, Waterworks Commission, Cincinnati, O.	1894
Hill, Nicholas, Jr., 100 William St., New York City	1911
Hillyer, William R., Assistant Commissioner Public Works, Borough of Richmond, New York City	1908
Hittell, John B., Chief Engineer of Streets, 207 City Hall. Chicago, Ill.	1908
Hoff, Carl P., Assistant City Engineer, St. Joseph, Mo.	1912
Hoffman, Robert, City Engineer, Cleveland, O.	1908
Hottell, Howard C., City Chemist, City Hall, Trenton, N. J.	1912
Howard, J. W., 1 Broadway, New York City	1901
Howe, W. B., City Engineer, Concord, N. H.	1895
Howell, Robert P., Town Engineer, Phillipsburg, N. J.	1908
Howell, William A., Engineer of Streets and Highways, City Hall, Newark, N. J.	1907
Hubbard, George W., Superintendent Light and Water, Elberton, Ga.	1911
Hudson, Leo, McKeesport, Pa.	1912
Hughes, T. C., City Engineer, Tulsa, Okla.	1912
Hutcheon, James, City Engineer, Guelph, Ont.	1899
Iredell, George, S., City Engineer, Austin, Texas	1908
Judson, Wm. P., Broadalbin, Fulton Co., N. Y.	1902
Kay, Edgar B., Tuscaloosa, Ala.	1906
Kelsey, Louis C., Salt Lake City, Utah	1908
Kendrick, Julian, 606 1st. National Bank Bldg., Birmingham, Ala.	1898
Kingsley, Edgar A., County Engineer, Pulaski Co., Little Rock, Ark.	1908
Kirkpatrick, Walter G., City Engineer, Birmingham, Ala.	1912
Kirschbaum, L., Asphalt Chemist to City of Chicago, Chicago, Ill.	1909
Klausmann, Henry W., City Engineer, City Hall, Indianapolis, Ind.	1912
Klodt, B. G., 526–530 Gunter Bldg., San Antonio, Texas	1912
Krause, Mark C., Engineer in Charge Construction of Light and Power, Spirit Lake Land Co., Spirit Lake, Idaho	1909
Lea, Lucian D., City Engineer, Lead, S. D.	1912
Lee, B. M., City Engineer, Asheville, N. C.	1908

	Membership Dates From
Legare, T. **Keith**, Assistant City Engineer, Columbia, S. C.	1909
Lenderink, **Andrew**, City Engineer, Kalamazoo, Mich.	1912
Levinson, **Henry**, City Engineer, Little Rock, Ark.	1909
Lewis, J. E., General Superintendent of the Fred A. Jones Co., Dallas, Texas	1912
Lewis, N. P., Chief Engineer, Board of Estimate and Apportionment, New York City	1895
Little, **John** C., City Engineer, Annapolis, Md.	1910
Lovewell, **Maurice** N., Assistant Engineer, South Park Commissioners, 57th and Cottage Grove Ave., Chicago, Ill.	1912
Lowry, J. W., Superintendent W. E & E. L. Plant, Box 387, Grenada, Miss.	1912
Ludlow, J. L., Winston-Salem, N. C.	1906
Luster, W. H., City Surveyor, Elizabeth, N. J.	1905
Lykken, H. G., City Engineer, Grand Forks, N. D.	1910
Lynch, F. G., Assistant to City Engineer, Erie, Pa.	1910
McCabe, **John** C., City Boiler Inspector, 410 City Hall. Detroit. Mich.	1912
McClanathan, R. A. Niagara Falls, N. Y.	1910
McCrary, S. K., City Engineer, 1011 Laramie St., Ft. Atchison, Kans.	1909
McCullough, **Ernest**, 2114 Fisher Bldg., Chicago, Ill.	1909
McGehee, **Ben** C., Little Rock, Ark.	1909
McKenna, M. F., City Engineer, Bridgeport, Conn.	1910
McKenzie, **Andrew** J., City Engineer, Webb City, Mo.	1910
McMath, **Robert** E., 327–328 Lincoln Trust Bldg. St. Louis, Mo.	1894
McNeal, **John**, City Engineer, Columbia, S. C.	1911
Macallum, **Andrew** F., City Engineer, City Hall, Hamilton, Ont.	1909
Macartney, **Morton**, City Engineer, Spokane, Wash.	1910
Maetzel, **Henry**, City Engineer, Columbus, O.	1908
Magruder, J. O., City Engineer, Danville, Va.	1911
Marcellus, J. B., Inspector for Board of Public Works, 820 N. 13th. St., Boise, Idaho	1909
Meade, R. E., 1520 Brown-Marx Bldg., Birmingham, Ala.	1906
Meriwether, B. B., care Birmingham Realty Co., Birmingham, Ala.	1908
Mesiroff, J. A., City Engineer, City Hall, Milwaukee, Wis.	1911
Metz, L. V., Assistant to City Engineer, Erie, Pa.	1910
Miller, B. F., **Jr.**. City Engineer, 902 Grove St., Meadville, Pa.	1910
Mitchell, J. W., Mayor, City Hall, Calgary, Alta.	1912
Mueller, **Alfred** C., Mayor, Davenport, Ia.	1912
Mullen, **Charles** A., Superintendent of Street Construction, Milwaukee, Wis.	1911

	Membership Dates From
MUNGLE, WILLIAM, Member Board of Works, Newark, N. J.	1910
MURPHY, F. E., Superintendent of Streets and Waterworks, Huntsville, Ala.	1906
MURPHY, M. D., Street and Sewer Director, Belvedere Apts., Wilmington, Del.	1912
MURRAY, JAMES P., Assistant City Engineer, 403 E. 22nd. St., Austin, Texas	1911
MYERS, GEO., Ft. Smith, Ark.	1912
NABERHUIS, H. A., City Engineer, Holland, Mich.	1911
NEVES, WILLIAM D., City Engineer, Greenville, S. C.	1908
NEWTON, SAM'L. D., Box 153, Greensboro, N. C.	1908
NICHOLSON, MAURY, City Hall, Birmingham, Ala.	1908
NICOL, WALTER H., Tuscaloosa, Ala.	1910
NOBLE, O. E., City Engineer, Manhattan, Kans.	1908
O'CONNELL, HARRY B., Member Board of Works, Newark, N. J.	1910
OGDEN, HENRY N., Professor of Sanitary Engineering, Cornell Univ., Ithaca, N. Y.	1909
OLMSTEAD, FREDERICK L., Brookline, Mass.	1909
O'NEILL, JOSEPH, City Engineer, Leavenworth, Kan.	1909
OSBORNE, E. M., Superintendent Light and Water Commission, Talladega, Ala.	1911
OWEN, JAMES, 196 Market St., Newark, N. J.	1904
OWEN, KENNETH D., Montclair, N. J.	1908
PARENT, ARTHUR, Superintendent City Lighting Department, Montreal, Canada	1905
PARKER, G. A., Superintendent of Parks, Hartford, Conn.	1902
PARKES, WILLIAM J., 101-3 Senyard Bldg., Pine Bluff, Ark.	1906
PARSONS, E. B., Watertown, Wis.	1908
PARSONS, MAURICE G., 1130 Forest Ave., Hollywood, Cal.	1912
PAYTON, LYLE, City Engineer, Moline Ill.	1912
PEALER, THOMAS, City Engineer, Indiana, Pa.	1910
PERRY, CHARLES E., Canajoharie, N. Y.	1911
PETERSEN, E. F., Muskogee, Okla.	1912
PHELPS, EARLE B., 30 Church St., New York City	1909
PHELPS, S. H., City Engineer, Sharpsville, Pa.	1911
PHILIP, JOHN W., City Engineer, Sarasota, Fla.	1911
PHILLIPS, W. W., City Engineer and County Surveyor, Cartersville, Ga.	1911
PHUL, WILLIAM VON, 921 Canal St., New Orleans, La.	1911
PIERCE, JOHN IRVIN, City Engineer, Jackson, Miss.	1912
PILLET, FREDERICK FISCHER, City Engineer, City Hall, Wilmington, N. C.	1912

	Membership Dates From
Pollock, Clarence D., Calle Cuba 24, Havana, Cuba	1902
Potter, Alexander, 50 Church St., New York	1913
Pray, James S., Chairman, Department of Landscape Architecture, Harvard University; Res. 50 Garden St., Cambridge, Mass	1910
Preston, J. M., City Engineer, Dallas, Texas	1908
Provost, A. J., Jr., 39–41 West 38th St., New York City	1904
Prow, John C., City and County Engineer, Salem, Ind	1909
Putnam, J. E., Assistant City Engineer, Rochester, N. Y	1907
Rankin, E. S., Engineer of Sewers and Drainage, Newark, N. J	1903
Reed, Merle H., City Engineer, Fort Smith, Ark	1912
Reimer, Frederic A., Ass't County Engineer, Court House, Newark, N. J	1909
Reppert, Charles M., Division Engineer, Bureau of Construction, Department of Public Works, 5912 Douglas Ave., Pittsburgh, Pa	1908
Reynolds, A. M., Chief Engineer, Essex County Park Commission, 60 Clifton Ave., Newark, N. J	1908
Rich, D. H., Water and Light Commissioner, Red Cloud, Minn	1912
Rich, E. D., Assistant Professor Civil Engineering, Ann Arbor, Mich	1910
Richardson, Clifford, 30 Church St., New York City	1911
Richards, H. S., Assistant Superintendent, South Park Commission, 5454 Greenwood Ave., Chicago, Ill	1909
Ridgway, Robert, Public Service Comm., 1st. Dist., Eng., of Subway Construction, 154 Nassau Street, New York City	1908
Riter, George W., Care Eureka Hill Mining Co., Salt Lake City, Utah	1905
Roberts, George W., City Engineer, South Omaha, Neb	1911
Roess, Gustav F., City Engineer, Oil City, Pa	1910
Rogers, D. D., City Engineer, Daytona, Fla	1908
Rogers, Niart, City Engineer, Asbury Park, N. J	1909
Rudolph, Charles A., Street and Sewer Director, 411 Delaware Ave., Wilmington, Del	1912
Rust, Charles H., City Engineer, Victoria, B. C	1898
Ruttan, H. N., City Engineer, Winnipeg, Man	1904
Sargent, Welland, Commissioner of Public Works, Municipal Bldg., Oak Park, Ill	1910
Shand, Gadsden E., Columbia, S. C	1908
Shaner, H. S., City Engineer, Lynchburg, Va	1908
Shannon, Charles A., City Engineer, Nebraska City, Neb	1910
Sharp, John C., Engineer of Sewers, City Engineer's Office, 908 E. Couch St., Portland, Ore	1912
Sherrerd, M. R., Chief Engineer, Department of Public Works, Newark, N. J	1896

	Membership Dates From
Shipman, Charles M., General Superintendent of Works, Newark, N. J.	1905
Shockley. P. S., City Engineer and County Surveyor, News Building, Salisbury, Md.	1911
Slattery, John L., Secretary-Treasurer, St. Johns Municipal Council, St. Johns, Newfoundland	1901
Sloan, M. S., Birmingham, Ala.	1911
Smith, Eugene, City Surveyor, Hoboken, N. J.	1908
Smith, Francis P., 24–26 E. 21st. St., New York City	1908
Smith, Thad. D., Aberdeen, Wash.	1911
Solotaroff, William, Superintendent Shade Tree Commission, East Orange, N. J.	1906
Southgate, William W., City Engineer, Nashville, Tenn	1908
Sparks, George W., President of Street and Sewer Board, Wilmington, Del.	1912
Spencer, George C., Superintendent Water and Light and City Engineer, Marianna, Fla.	1912
Sprague, Norman S., Superintendent Bureau of Construction, Pittsburgh, Pa.	1908
Stallings, Robert, Little Rock, Ark.	1912
Steed, Robert E., City Clerk, 438 Fairfax Ave., Norfolk, Va.	1911
Stevenson, John D., Assistant Engineer, Bureau of Construction, in charge of North Side Office, 1231 Monterey St., North Side, Pittsburgh, Pa.	1912
Strachan. Joseph, 352 Putnam Ave., Brooklyn, N. Y.	1905
Sullivan, W. A., Manager, Shreveport Traction Co., Shreveport, La.	1909
Talbot, A. N., Professor of Municipal and Sanitary Engineering, University of Illinois, Urbana, Ill.	1903
Taylor. Alex. J., Engineer in Charge of Sewers, Wilmington, Del.	1908
Taylor, Charles F., 900 Lewis Bldg., Pittsburgh, Pa.	1908
Thomas, J. Fred., County Surveyor, Mercer Co., Farrell, Pa.	1912
Thomes, Edward C., City Engineer, Poplar Bluff, Mo.	1910
Thompson, J. Edgar, City Engineer, Knoxville, Tenn.	1910
Thompson, S. C., Principal Assistant Engineer, Bureau of Highways, Borough of Bronx, New York City	1904
Thum, William, Mayor, Pasadena, Cal.	1912
Tillson, George W., Consulting Engineer to Borough President, Brooklyn, N. Y.	1896
Tonson, George W., 2056 Warren St., Toledo, O.	1911
Tribus, Louis L., 86 Warren St., New York City	1908
Van Trump, Isaac, 2337 S. Paulina St., Chicago, Ill.	1911
Van Zuben, Frank J., Acting City Engineer, Ft. Worth, Tex.	1912
Wadsworth, Charles S., 205 Chamber of Commerce Bldg., Birmingham, Ala.	1908

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Waite, H. M., Chief Engineer, Cincinnati, O.	1912
Watson, Robert M., Borough Engineer, Rutherford, N. J.	1906
Waugh, R. D., Controller of Works, Winnipeg, Man.	1911
Weatherford, J. H., City Engineer, Memphis, Tenn.	1908
Weber, Philip H., City Engineer, Canton, Ohio.	1910
Welborn, M. C., Chief Engineer of Sewers, Austin, Texas.	1912
Wentworth, Russell A., City Engineer, Batavia, N. Y.	1911
Wetmore, W. G., City Engineer, Meridian, Miss.	1909
Wheeler, Delbert, City Engineer, Clarinda, Ia.	1910
Wheeler, Holland, City Engineer, Lawrence, Kan.	1905
Wheelock, D. F. A., City Engineer, Warren, Pa.	1910
Whipple, George C., 103 Park Avenue, New York City.	1905
White, Linn, Chief Engineer, South Park Commissioners, Chicago, Ill.	1908
Whitman, Ezra B., Water Engineer, City Hall, Baltimore, Md.	1912
Whitney, Harrie L., City Engineer, Beverly, Mass.	1908
Whyman, R. O., Amarillo, Tex.	1912
Wickham, J. Q., City Engineer, Ames, Ia.	1911
Willigerod, William D., City Engineer, City Hall, East Orange, N. J.	1911
Willis, L. C., Superintendent of Construction, O'Neill Engineering Co., Dallas, Texas.	1909
Wills, Joe B., Chief Sanitaty Inspector, City Hall, Dallas, Texas.	1912
Wilson, James, Superintendent of Water Works, Calgary, Alta.	1912
Wilson, W. M., Engineer, Board of Public Works, Rome, Ga.	1906
Wingfield, Nisbet, City Engineer and Commissioner of Public Works, Rome, Ga.	1906
Young, Alexander R., City Engineer, Topeka, Kan.	1911

Affiliated members

Norman, W. H., Dallas, Texas.	1912
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The American Asphaltum & Rubber Co., 600–614 Harvester Bldg., Chicago, Ill.	1911
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Blome Co., Rudolph S., Bank Floor, Unity Bldg., Chicago, Ill.	1908
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Briddel, York, General Superintendent, Graves-Matthews Paving Co., Birmingham, Ala.	1911
Buffalo Steam Roller Co., Buffalo, N. Y.	1905
Burns, Bob, Assistant Sales Manager, Iola Portland Cement Co., 3120 San Jacinto, Dallas, Texas	1912
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Colborne, B. B.	1910
Collier, Henry L., Engineer, Yellow Pine Mfrs. Assn., 707 Lumbermens Bldg., St. Louis, Mo.	1908
Creosoted Wood Paving Block Assn., First National Bank Bldg., Chicago, Ill.	1911
Cullinan, H. J., Care The Texas Co., Houston, Texas	1912
Curless, Will A., Cement Engineer, Rep. Western Glazed Cement Pipe and Machinery Co., Seattle, Wash.	1912
Cutter, Frank G., Rep. Warren Brothers Co., 1349 Otis Bldg., Chicago, Ill.	1912
Dixon, W. W., Care Union Clay Products Co., 50 Church St., New York City	1911
Doane, S. E., 4411 Hough Ave., Cleveland, O.	1911
Dodge, C. P., Care The Texas Co., Houston, Texas	1911
Dunn, Frank B., Secretary and General Manager, Dun Wire-Cut-Lug Brick Co., 309 Monroe St., Conneaut, O.	1911
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Goodrich, E. H., General Sales Agent, Mack Manufacturing Co., 2242 Land Title Bldg., Philadelphia, Pa.	1910
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Head, James M., Attorney-at-Law, 59 Temple Place, Boston, Mass.	1911
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Horn, J. Merrick, Warren Bros. Co., Ford Bld'g., Wilmington, Del.	1913
Horton, D. C., Jacksboro, Tex.	1912
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Ingram, G. M., President, Southern Bitulithic Co., 602 First Nat'l. Bank Bldg., Nashville, Tenn.	1905
International Creosoting & Construction Co., Galveston, Texas	1909
Jackson, Newton, General Agent, U. S. Wood Preserving Co., Oak Lane, Philadelphia, Pa.	1908
Johnson, Alfred H., President, Texas Bitulithic Co., Praetorian Bldg. Dallas, Texas	1908
Kaull, Pardon S., President, Kansas Bitulithic Co., American National Bank Bldg., Kansas City, Mo.	1909
Kemp, L. W., Salesman for the Texas Co., 216 N. Haskell Ave., Dallas Texas.	1912
Lamson, George W., Agent, Union Oil Co. of Cal., Railway Exchange Bldg., Chicago, Ill.	1911
Lindsay, Gordon I., Robeson Process Co., Pennington, N. J.	1911
Loud, Henry S., Chief Engineer, U. S. Wood Preserving Co., Morristown, N. J.	1908
McAvoy, John C., Secretary and General Manager, McAvoy Vitrified Brick Co., Broad and Arch Streets, Philadelphia, Pa.	1905
McGrath, George B.	1909
MacKendrick, W. G., 103 Bay St., Toronto, Ont.	1911

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Manning, F. L., Sales Manager, Peebles Paving Brick Co., Portsmouth, O.	1912
Meriwether Coleman, President, Lock-Joint Pipe Co., 165 Broadway, New York City	1908
Miner, H. A., President, Steel Protected Concrete Co., Trust Bldg., Philadelphia, Pa.	1908
Municipal Journal, 50 Union Square, New York City	1908
Mussen, W. H. C., 299 St. James St., Montreal, Canada	1905
Norton, B. V., Secretary, Union Clay Products Co., 50 Church St., New York City	1911
Parmley, Walter C., Everett Bldg., Union Square, New York City	1908
Pittsburg Filter Co., Pittsburgh, Pa.	1905
Power Specialty Co., 111 Broadway, New York City	1908
Reed, Alexander, U. S. Wood Preserving Co., 165 Broadway, New York City	1901
Reilly, P. C., President, Republic Creosoting Co., Indianapolis, Ind.	1907
Robinson, E. M., Southern Bitulithic Co., 602 First National Bank Bldg., Nashville, Tenn.	1910
Rudd, A. E., Secretary-Treasurer, General Construction Co., 143 Cambridge St., Guelph, Ont.	1912
St. Marys Sewer Pipe Co., St. Marys, Pa.	1910
Sanders, R. W., Milford, Clermont Co., O.	1911
Sawin, Geo. A., Elec. Eng'r. with Public Service Electric Co., 759 Broad St., Newark, N. J.	1913
Schutte, August E., Consulting Chemist, Warren Bros. Co., Boston, Mass.	1911
Smith, W. Stuart, District Manager, Warren Bros. Co., 49 West Ave., Rochester, N. Y.	1911
Spencer, W. B., 2 Rector St., New York City	1912
Standard Asphalt & Rubber Co., 137 La Salle, St., Chicago, Ill.	1908
Stubbs, R. C., 1418 Praetorian Bldg., Dallas, Texas	1912
Tenney, George O., President, Atlantic Bitulithic Co., Richmond, Va.	1906
Thurston, George W., Secretary, Western Paving Brick Mfrs. Assn., 500 Ridge Bldg., Kansas City, Mo.	1912
Tipper, Harry, care the Texas Co., 17 Battery Place, New York City	1909

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WHITLEY, FRANK, Representative of Ockander Bros., Hillsboro, Texas 1912
WRIGHT, G. W., President, Oklahoma Glazed Cement Pipe Co., Tulsa, Okla. 1912
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First Annual Convention	1894	Buffalo, N.Y.
Second Annual Convention	1895	Cincinnati, O.
Third Annual Convention	1896	Chicago, Ill.
Fourth Annual Convention	1897	Nashville, Tenn.
Fifth Annual Convention	1898	Washington, D. C.
Sixth Annual Convention	1899	Toronto, Canada.
Seventh Annual Convention	1900	Milwaukee, Wis.
Eighth Annual Convention	1901	Niagara Falls, N. Y.
Ninth Annual Convention	1902	Rochester, N. Y.
Tenth Annual Convention	1903	Indianapolis, Ind.
Eleventh Annual Convention	1904	St. Louis, Mo.
Twelfth Annual Convention	1905	Montreal, Canada.
Thirteenth Annual Convention	1906	Birmingham, Ala.
Fourteenth Annual Convention	1907	Detroit, Mich.
Fifteenth Annual Convention	1908	Atlantic City, N. J.
Sixteenth Annual Convention	1909	Little Rock, Ark.
Seventeenth Annual Convention	1910	Erie, Pa.
Eighteenth Annual Convention	1911	Grand Rapids, Mich.
Nineteenth Annual Convention	1912	Dallas, Tex.
Twentieth Annual Convention	1913	Wilmington, Del.

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Sewerage and Sanitation

	Length, Pages	Year of Publication
*Street and Sewer Work of Indianapolis. By W. B. Holton	5	1895
*School Hygiene. By Dr. Mary E. Donahue	2	1895
*The Construction of Pipe Sewers at Washington to Prevent Root Intrusion. By Capt. Lansing H. Beach	7	1896
*Sewers and Sewage Disposal of Chicago. By G. L. Clausen	4	1896
*School Inspection as a Means of Preventing the Spread of Contagious Diseases. By J. M. Witherow	4	1897
*Report of a Commission of Experts Concerning the Agricultural Utilization of Vienna Sewage. Translated by Capt. Lansing H. Beach	29	1898
*The Sewerage of Baltimore. By Kenneth Allen	6	1898
*The Sewage Disposal Project for Washington, D. C. By D. E. McComb	7	1898
*Some Observations on the Effect of Flushing Devices for Small Sewers. By A. E. Phillips	13	1898
*Is a House Sewer-Trap Always Necessary. By Chas. B. Ball	4	1899
*Sewage Disposal and Water Purification. By John N. McClintock	10	1900
*Sewage Purification. By E. A. Hermann	8	1900
*The Situation Regarding the Question of Sewerage in Baltimore. By Kenneth Allen	3	1900
*Sanitary Plumbing in Public Schools. By Chas. B. Ball	7	1900
*Recent Progress in Sewage Purification in England. By Gilbert J. Fowler	14	1900
*General Conclusions Derived From the Experimental Bacterial Treatment of Raw Sewage at London, England. By Dr. Frank Clowes	3	1900
*Municipal Sewerage Systems and Assessments for Same. By Geo. T. Bouton	5	1900

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Estimation of the Cost of Sewer Construction. By Emmett Steece	6	1901
State Legislation and Municipal Sanitation. By O. H. Landreth	3	1901
The New Sewage Disposal Plant of Madison, Wis. By F. E. Turneaure	8	1901
*Biological System of Sewage Disposal. By John McClintock	9	1902
*Municipal Sanitation. By A. Prescott Folwell	8	1902
*Practical Operation of Sewage Purification Plants. By John W. Alvord	17	1902
*Residential Septic Tanks. By B. J. Ashley	5	1902
*Sanitary Science and the Public Health. By David H. Judd	3	1902
*Sewer Maintenance—Under Whose Supervision and Why. By John H. Emigh	5	1902
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Sewage Disposal as Applied to Small Cities and Towns. By T. Chalkley Hatton	10	1904
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The Joint Construction and Operation of Sewerage Works; the Drainage District as Distinct from the Municipality. By E. S. Rankin	13	1908
Importance of the Proper Operation of Water and Sewage Purification Plants. By George W. Fuller	19	1908
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*Present Use of the Septic Tank. By Prof. H. N. Ogden	12	1910
*Report of Committee on Sewerage and Sanitation. By George C. Whipple, Chairman	1	1910
*Municipal Sanitation in Cuba (Illustrated). By R. Winthrop Pratt	13	1910
*Construction of Exposed Sewers at Leavenworth, Kan. (Illustrated). By Joseph O'Neil	7	1910
*Sewage Disposal System of Toronto (Illustrated). By C. H. Rust	13	1910
*European Sewage Disposal Works (Illustrated). By Rudolph Hering	14	1910
Report of Committee on Standard Sewerage Specifications. E. J. Fort, Rudolph Hering and Andrew Provost, Jr.	22	1911
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Chicago Sewage Disposal Experiment Station. By Langdon Pearse	11	1911

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*Quality of Public Water Supply. By John W. Hill	8	1895
*Water Supply of Newark. By Henry E. Bailey	3	1895
*The Water Supplies of Eight Cities in Relation to Typhoid Fever Rates. By John W. Hill	9	1896
*Water Supply. By John L. Kennedy	3	1896
*Investigation of Quality of Water for Public Use. By A. S. Tuttle	10	1896
*Some Features of the Brooklyn Water Supply as Presented by I. M. De Verona, in a Recent Report. By M. R. Sherrerd	7	1896
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*Water Rates and Statistics Pertaining Thereto in the Larger Cities of the United States. By August Herrmann	18	1899
*Sewage Disposal and Water Purification. By John N. McClintock	10	1900
*Improvements of Water Supplies. By G. Bouscaren	4	1900
The Water Meter as a Sanitary Agent. By M. N. Baker	3	1901
*History of the Distributing System of the Rochester Water Works. By William M. Radenhurst	6	1902
*Specifications, Testing, Installation and the Cost of Water Meters. By G. A. Hotchkin	15	1902
*State Water Supply. By George W. Rafter	5	1902
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Indianapolis Water Works and Matters Pertaining to Water Works Generally. By F. A. W. Davis	8	1903
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*Purification of Water by Copper Sulphates. By Daniel D. Jackson	10	1905
*New Orleans Water Works. By George G. Earl	14	1906
*Cost of Cleaning and Grubbing a Reservoir Site. By Julian Griggs	6	1906
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Sewage Purification vs. Water Purification. By George C. Whipple	7	1908
Importance of the Proper Operation of Water and Sewage Purification Plants. By George W. Fuller	19	1908
*Improvements in Check Valves on Auxiliary Water Supplies (Illustrated). By J. Walter Ackerman	7	1910
Water Purification Plant of Grand Rapids. By J. W. Armstrong	21	1911

Roads and Pavements

*Specifications for Vitrified Paving Brick. By W. S. Wilkins	6	1895
*Street and Sewer Work of Indianapolis. By W. B. Holton	5	1895
*Street Paving in Newark. By Harrison Van Duyne	3	1895
*The Need of a Laboratory for the Testing of Asphalt and Asphalt Pavements. By Nelson P. Lewis	7	1896

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Corry Brick and Tile Company	Corry, Pa.
United Brick Company	Conneaut, Ohio

DURING THE YEAR 1911

Sterling Brick Company	Olean, N. Y.
Reynoldsville Brick & Tile Company	Reynoldsville, Pa.
Danville Brick Company	Danville, Ill.
Patterson Clay Products Co.	Clearfield, Pa.

DURING THE YEAR 1912

Wabash Clay Company	Veedersburg, Ind.
Clinton Paving Brick Company	Clinton, Ind.
Alton Brick Company	Alton, Ill.
Deckman-Duty Brick Company	Cleveland, Ohio
Tuna Valley Pressed Brick Co.	Bradford, Pa.
Foster Paving Block Co.	Bradford, Pa.
Metropolitan Paving Brick Co.	Canton, Ohio
Bessemer Limestone Company	Youngstown, Ohio
Peebles Paving Brick Co.	Portsmouth, Ohio
Murphysboro Paving Brick Co	Murphysboro, Ill.
Binghamton Paving Brick Co	Binghamton, N. Y.

WIRE-CUT-LUG BLOCKS MADE

In 1909	27,000
In 1910	3,666,000
In 1911	12,101,000
In 1912	27,024,238

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*Street Paving in Syracuse, N. Y. By Robert Ballard	3	1896
*Regulations Concerning the Openings in Pavements by Corporations or Plumbers in Washington, D. C. By Capt. Lansing H. Beach	8	1896
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*Improved Streets and Care of Same. By M. A. Downing	5	1896
*Upon the Noise of Brick Pavements. By Ernest Adam	4	1896
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*Specifications for Asphaltic Mixtures and Tests for Same. By A. W. Dow	9	1896
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*Rumbling in Brick Pavements. By Ernest Adam	2	1897
*Results of One Year's Work With a Chemical Laboratory for Testing Asphalts. By George W. Tillson	6	1897
*Standard Tests for Paving Brick. By M. L. Holman	35	1897
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*The Relative Values of Paving Materials. By George W. Tillson	9	1898
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*Physical Properties of Asphalts and Asphaltic Cements. By W. H. Broadhurst	5	1899
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*Creosoted Wood Block Pavements in Indianapolis. By M. A. Downing	4	1899
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*The Value of Chemical Tests on Asphalt Mixtures. By W. H. Broadhurst	3	1900
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*Work of the Massachusetts Highway Commission. By T. W. McClintock	13	1902
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Concrete Pavements. By C. H. Rust	3	1904
Five Years' Operation of the Winnipeg Municipal Asphalt Plant. By H. N. Ruttan	12	1904
Notes on Tests for Wood Paving Block. By F. A. Kummer	5	1904
The Bitulithic Pavement. By Fred. J. Warren	5	1904
*Gutters and Crosswalks. By W. J. Stewart	2	1905
*Montreal's Civic Asphalt Plant. By John R. Barlow	2	1905
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*Pavements and Paving Materials. By J. W. Howard	3	1905
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*Chert Roads. By Prof. Edgar B. Kay	5	1906
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Bituminous Pavements on Macadam Base (Illustrated). By Linn White	8	1909
Concrete Pavement Now being Laid in Boise, Idaho. By J. B. Marcellus	6	1909
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*Report of Committee on Paving. By William A. Howell, Chairman	3	1910

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*Bituminous Pavements, Patented and Otherwise. By E. A. Kingsley	18	1910
*Repairing Asphalt Pavements (Illustrated). By Henry C. Allen	8	1910
*Economics of Modern Highway Engineering. By Prof. A. H. Blanchard	11	1910
*Supervision of Municipal Work. By Will P. Blair	15	1910
*Paving Methods in Erie (Illustrated). By F. G. Lynch	12	1910
*Report of Committee on Standard Specifications. By C. H. Rust, Chairman	2	1910
*Report of Sub-Committee on Wood Block Specification, By A. W. Dow, Chairman	14	1910
*Report of Sub-Committee on Brick Paving Specifications. By E. H. Christ, Chairman	2	1910
*Report of Sub-Committee on Asphalt Pavement Specifications By F. P. Smith	15	1910
Report of Committee on Street Paving. William A. Howell, Chairman	4	1911
Bituminous Concrete Pavements. By H. G. Lykken	16	1911
Bitucrete, Its Development and Use. By A. E. Schutte	6	1911
Standard Tests for Asphalt Cements. By J. W. Howard	9	1911
Grouted and Sand Filled Brick Pavements. By Maury Nicholson	9	1911
Contraction and Expansion of Vitrified Brick Pavements. By Will P. Blair	7	1911
Standard Brick Pavement Specifications	17	1911
Standard Asphalt Pavement Specifications	11	1911
Report of Committee on Bituminous Paving Nomenclature. Linn White, Chairman	3	1911

Street Lighting

	Length, Pages	Year of Publication
*Electrolysis Prevention. By Harold P. Brown	7	1895
*Municipal Control and Inspection of Electrical Construction in Cincinnati. By John A. Cabot	4	1896
*Outages. By J. A. Cabot	6	1896
*The Latest Method of Electrolysis Prevention. By Harold P. Brown	7	1897
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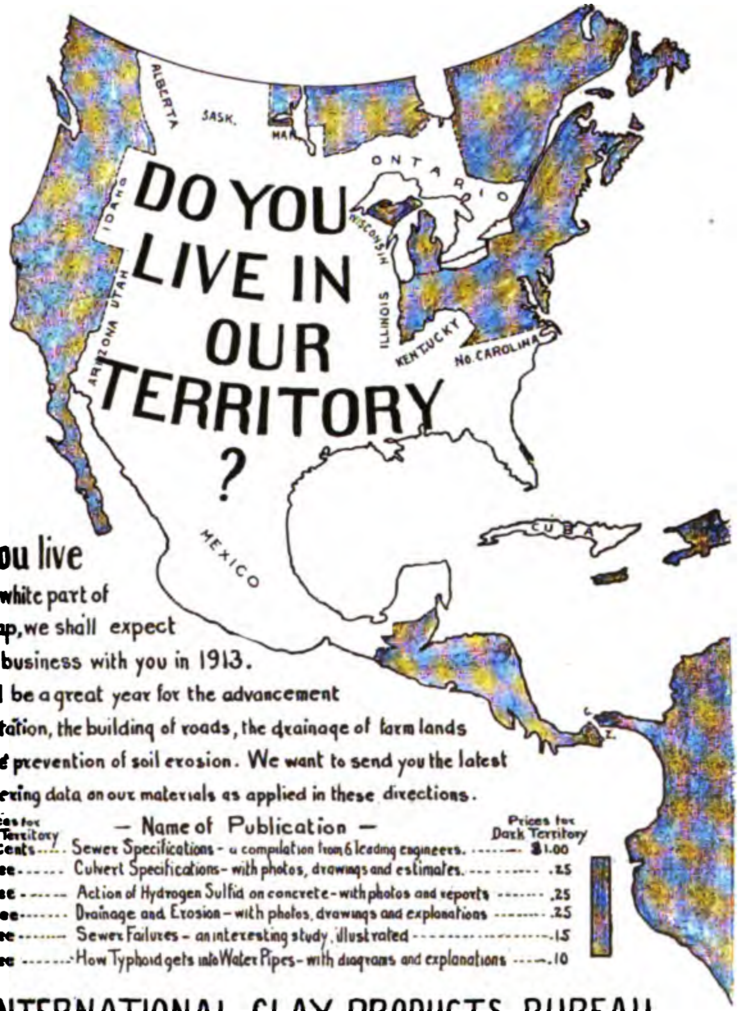

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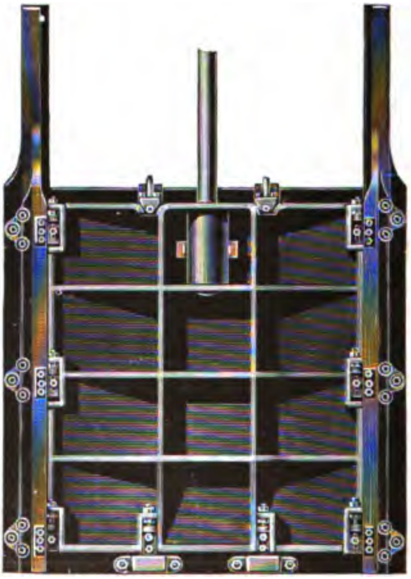

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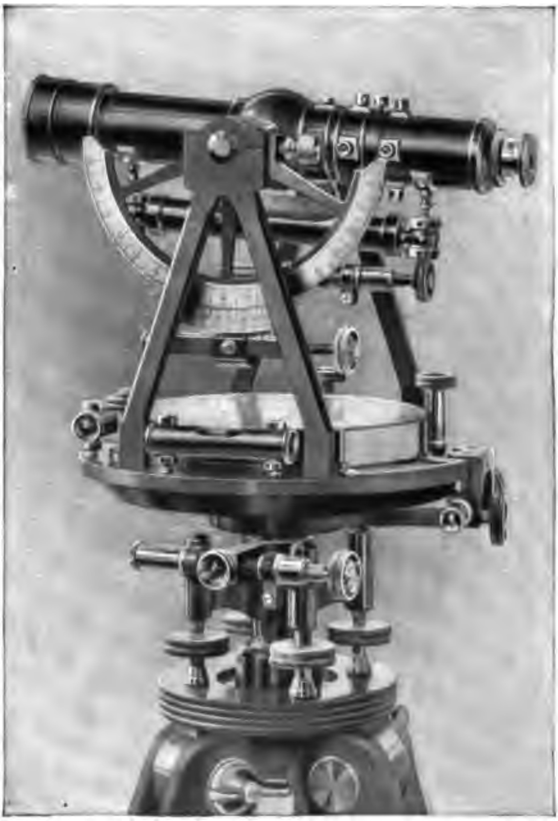

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